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ABSTRACT

This guide to the core curricula for the training of microcomputer technicians is designed for school leavers after 10 or more years of general/vocational education with a science and mathematics background. The 2-year course is to be administered in four semesters. An introductory outline of course design and curricula provides the rationale, entry level and entry criteria, job functions that course completers can perform, course objectives, course pattern, course contents, teaching and support staff, and assessment scheme. The course contains 15 units, each of which consists of learning units. Each unit begins with a list of objectives, theory and practical content, and a list of references. Course unit titles are as follows: industrial organization and communication; electronic components, hardware, and devices; basic electronic engineering; workshop practice; electronic circuits and linear integrated circuits; digital electronics and test equipment; electronics drafting; project work in electronics; microcomputer hardware; computer organization and high-level programming; project work in microprocessors; computer installation and maintenance; computer peripherals; system diagnostics and fault-analysis; and project work in hardware and data communications. Information on staffing requirements, a recommended list of equipment and machinery, and a list of acronyms used in the document are also provided. (YLB)

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CORE CURRICULA FOR
MICRO COMPUTER TECHNICIAN COURSE

PREFACE

Based on Unesco's policy instrument, the Revised Recommendation concerning Technical and Vocational Education, which was adopted during the 1974 General Conference, and in conformity with the Approved Programmes 23C/5 and 24C/5, a number of guides have been reproduced in the field of technical and vocational education to reflect experiences gained in field projects and national institutions. These guides serve experts and national counterparts in the execution of projects in various fields. Some of the guides are also of interest to curriculum developers and to teacher educators. Sometimes they also serve as working documents in workshops and seminars.

These guides should be considered as internal working documents which continually require revision and updating.

This guide to the core curricula for the training of micro computer technicians was prepared, under contract, by the Royal Melbourne Institute of Technology, Australia and the Technical Teacher Training Institute, Madras India. It was experimented with and commented on by three countries. The present version was finalized by Mr. Ray Brunskill, Department of Applied Computing and Information Systems, Teeside Polytechnic, Middlesborough, United Kingdom, and is based on comments by a group of consultants who participated in a consultation meeting hosted by the Technical Teacher Training institute, Madras, India, in November 1989, under the auspices of Unesco.

This guide is intended to assist policy makers, education planners, curriculum developers and technical and vocational education institutions, in revising and updating similar existing curricula or adopting and introducing this curricula into technical and vocational education courses offered by technician training institutions.

The views, however, expressed in this document are those of the individuals concerned, and do not necessarily reflect those of Unesco. Furthermore, this core curricula should be treated as a prototype that could be used as it is prepared in this document or modified to suit the individual needs and objectives of the different institutions.

This guide to the core curricula for the training of micro computer technicians was prepared and written by a group including representatives from educational establishments and industrial organisations who were experienced in the training and employment of micro computer technicians. This document represents the final version of a draft which was widely circulated and revised in the light of the many remarks and constructive critisisms received. In particular a revision was presented and discussed at a consultation meeting organised and hosted by the Technical Teachers Training Institute, Madras between 20th and 24th Novemeber 1989, under the auspices of UNESCO. The participants on that occasion were:

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OUTLINE OF COURSE DESIGN AND CURRICULA

1.0 RATIONALE

1.1 Computers are increasingly finding their way in all callings and walks of life. They are being extensively used by institutions, organisations and individuals for a variety of purposes. Access to them is becoming easier and popular because of the emergence or various kinds of programming languages and configurations ranging from simple home computers to complex super computers.

1.2 Convinced of their potential and multiple advantages, many developing countries all over the world are giving increased importance to the development and deployment of several types of computers for modernising their operations. Many of these countries have also collaboration with the leading computer manufacturers in the world paving the way for standardisation of the hardware and software technology.

1.3 These countries are also engaged in the development of manpower of different categories to cope with the increase in the volume of work relating to software and hardware. At the level of technicians, a large number of personnel are needed to install, maintain and service the computers, requiring organisation of computer technician courses in every country.

1.4 This document aims at preparing an outline course design and core curricula for computer technicians to facilitate the concerned countries for its adoption with necessary modifications where necessary to suit to their local conditions. Greater emphasis is laid on micro computers as they are currently being used very extensively in many countries

2.0 COURSE TITLE: MICRO COMPUTER TECHNICIAN COURSE

3.0 ENTRY LEVEL AND ENTRY CRITERIA

This course is designed for school leavers after ten or more years of general/vocational education with Science and Mathematics background which culminate in acquisition of pre-requisite competencies as detailed in Appendix 1 at the end of this section.

4.0 The Course will be of two years duration, administered in four semesters.

5.0 AWARD

The successful canditate of the course will be awarded a Certificate or Diploma depending upon the practice prevalent in the countries concerned in respect of vocational trade courses of this nature.

6.0 JOB FUNCTION

The curricula of the course are designed to develop adequate skills and knowledge to carry out the following type of functions generally associated with the job descriptions typically set for the computer technicians.

A - Prepare final drawings of computer related products in electronic design and drafting offices comprising Circuit diagrams, Schematic diagrams, Logic diagrams, Layout diagrams, Block diagrams, PCB diagrams and mechanical drawing such as Chassis, Panel, Console & Cabinets

B - Assist R & D Engineers in the assembly & testing of prototype at Circuit and Board level

C - Work in the assembly line of micro computer systems relating to interpretation of drawings, assembling, testing, inspection at component, board and unit level

D - Work in the purchase and stores department of computer industry to inspect, test, accept and maintain inventory of components, sub-assembly and peripherals of computers

E - Install and commission micro computers and networks

F - Carry out preventive maintenance on peripherals, such as printers, floppy drives, key boards, tape units, plotters

G - Attend to customer calls for trouble shooting and servicing of micro computers and its peripherals and networks

7.0 Course Objectives

To fulfil successfully the job functions, special skills, knowledge and attitudes are required:

Basic Knowledge in:

- electrical engineering
- measurements
- computer organisation and microcomputer hardware
- programming of microcomputers
- digital communication, interfacing, networking

Skills in:

- assembly and testing
- installation
- maintenance
- trouble shooting of microcomputers and related equipment
- oral, written and visual communication

Appropriate attitude:

- towards customers, peers and managers

From this requirement, the following course objectives should be stressed:

- Develop skill in the assembly and testing of electronic circuits containing microprocessors
- Install, maintain and service a microcomputer system and its peripherals
- Install auxillary units such as voltage stabilisers, air conditioners, uninterruptible power supply devices
- Interpret the customer call of computer break down and rectify the units avoiding undue delays
- Check the computer peripherals such as VDU, keyboard floppy disc drives, printers, digitisers, plotters, mouse and light pen for correct operation and replace defective electronic or mechanical parts
- Carry out regular servicing and maintenance to microcomputers and their peripherals
- Learn how to indentify, diagnose and replace the defective parts at board and chip level
- Prepare and interpret the electronic circuit, block, schematic and layout diagrams associated with microcomputer system hardware
- Use relevant technical catalogues and interpret the technical specifications of microcomputer system components

- Become familiar with active and passive components in electronic circuits, their function, and their physical and electrical specifications
- Study fundamental measuring techniques and be able to handle effectively analog and digital measuring and test equipment
- Understand the basic principles of the operation of computers. Become familiar with the typical structure and basic principles of operation of microcomputers in common use today
- Understand and check the functions of a CPU, memory cards, control units and interfaces at the board level
- Become familiar with the instruction set and assembly programming of commonly used micro processors
- Become familiar with the system software of microcomputers, and with the use of a selected operating system
- Become familiar with the fundamental principles of digital communications using buses and interfacing techniques
- Demonstrate acceptable standards in written and oral communications
- Maintain harmonious human relations with the parent organisation and its customers

8.0 COURSE PATTERN

8.1 Theory and Practice

Vocational courses of this type are generally designed to comprise related theory and practice in the ratio of 20:80. As this vocational area of computers is highly sensitive and sophisticated, the technicians are required to possess sound theoretical knowledge and practical experience in the related courses of study ranging from 30% to 40% theory to about 70% to 60% in practical work.

8.2 Software and Hardware

Though these technicians are mainly required to deal hardware, some essential knowledge of software becomes necessary to carryout the functions in an integrated manner. The course is therefore patterned to concentrate mainly on the hardware with an appropriate mix of software in relevant areas.

8.3 Institutional and Industrial training

In order to cross-fertilize institutional instruction with field practices, it is essential to arrange a large number of industrial visits, carryout project work in collaboration with computer industry and even place the students for short spells of industrial training. These arrangements will go a long way to enable the students to develop proper perspectives about the computer industry, its organisational structure and the roles and functions of the computer technicians.

9.0 COURSES OF STUDY

In consideration of the requirements relating to the above job functions, objectives and course pattern, the course is designed to compromise the following subjects of study:-

A Foundation subjects:

Industrial organisation & communication
Workshop practice

B Basic Supporting subjects:

Electronic components, Hardware & Devices
Basic electrical engineering
Electronics drafting

C Vocational subjects

Electronic circuits and Linear ICs
Digital electronics and test equipment
Micro computer hardware
Micro processors
Computer organisation and programming
Computer peripherals
Computer installation and maintenance
System diagnostics and fault analysis
Project
Data Communication

10.0 COURSE CONTENTS

The details of objectives, Learning units with sub- objectives along with the Contents of theory and practicals, for each of the above subjects, as derived from the job functions are given in the section under "Course curricula" of this document.

11.0 Sequencing of subjects is done on the basis of knowledge and skills required at various stages during the course. Semester pattern is recommended to facilitate coverage of relevant subjects in full, logical development of knowledge and skills and even distribution and tight schedule of work throughout the course. The instructional hours available at the rate of 30 hours per week for 20 weeks per semester are distributed between the theory and practice in the ratio already decided. Weightage of marks for performance assessment is given on the basis of significance of each subject of study with reference to its potential to provide the indentified knowledge and skills. The scheme of studies formulated on the basis of above consideration is given below:

I SEMESTER

Sl.No	Subjects of Study	Th. Hrs/ Wk	Pr. Hrs/ Wk	Total Hrs	Assess-ment marks (Weigh-tage)
1.1	Indust. organisation & communication	2	2	80	100
1.2	Electronic components, Hardware & Devices	4	6	200	200
1.3	Basic Electrical	4	6	200	200
1.4	Workshop Practice	-	6	120	100
	TOTAL	10	20	600	600

II SEMESTER

Sl.No	Subjects of Study	Th. Hrs/ Wk	Pr. Hrs/ Wk	Total Hrs	Assess-ment marks (Weigh-tage)
2.1	Electronic circuits and Linear ICs	4	6	200	200
2.2	Digital electronics & Test Equipments	4	6	200	200
2.3	Electronics Drafting	-	4	80	100
2.4	Project work in Electronics	-	6	120	100
	TOTAL	8	22	600	600

III SEMESTER

Sl.No	Subjects of Study	Th. Hrs/ Wk	Pr. Hrs/ Wk	Total Hrs	Assess-ment Marks (Weigh tage)
3.1	Micro computer Hardware	3	5	160	200
3.2	Micro Processors	3	5	160	200
3.3	Computer organisation & BASIC Programming	3	5	160	100
3.4	Project work in Micro Processors	-	6	120	600
	TOTAL	9	21	600	600
	* Alternatively				
	Project Work in Micro Processors	-	3	60	50
	Networks	2	1	60	50

IV

Sl.No	Subjects of Study	Th. Hrs/ Wk	Pr. Hrs/ Wk	Total Hrs	Assess-ment marks (Weigh-tage)
4.1	Computer Installation Maintenance	3	3	120	100
4.2	Computer Peripherals	3	6	180	200
4.3	System diagnostics & fault analysis	3	6	180	200
4.4	Project Work in Hardware	-	6	120	100
		9	21	600	600
	* Alternatively Project work in Hardware	-	3	60	50
	Data Communication	2	1	60	50

12.0 RESOURCES AND FACILITIES

The resources and facilities comprising class rooms, laboratories, workshops and other amentities; equipment, tools, accessories and instructional aids, furniture and library may be in tune with the norms and standards given under the section "Resource Requirements" of this document.

13.0 TEACHNING AND SUPPORTING STAFF

The teaching staff nominated for this course are required to be well qualified in Digital electronics, micro processors and Computer hardware and also possess rich practical experience in the micro computer field. They also need encouragement to undergo training and retraining programmes on a continuing basis to update and upgrade their level of proficiency and competence. Additionally, properly qualified and trained supporting staff are needed in adequate numbers for effective implentation of the course. The projected requirements of the staff are given in the section 'Resource Requirements' of this document.

14.0 ASSESSMENT SCHEME

The instruction and training provided to the students must be assessed continuously through written tests, practical and oral examinations and the students' individual progress must be closely monitored. It is recommended that end of course assessment be made for theory and practical of all subjects for each semester and the final grade of the student be based on continuous assessment and end examinations. A suitable scheme may be worked out in tune with other vocational courses offered in the respective coutries, keeping in view the relative weightage indicated for each subject in the Course Pattern.

15.0 COURSE ADMINISTRATION

In order to chieve the desired objectives of the course, it is essential to administer the course in accordance with the guidelines given in the section under "Course Curricula".

In institutions where Electronic technicians are trained for various special vocations such as Radio & T.V., Electronic Instrumentation, Medical Electronics, radar etc., the first two semesters proposed in this curriculum could be common with other trades and the final two semesters will enable them to become micro computer technicians and the course could be fitted to suit individual countries practices.

APPENDIX 1

COURSE ENTRY CRITERIA

There are many background skills and competencies required for the learning process to be successful. These background skills apply to many topics or units and it is beyond the scope of the course to teach the background requirements.

The entrance criteria are suggested in an attempt to avoid possible learning difficulties which may confront students in undertaking this course.

In the following sections the prerequisite skills in the fields of language skills, science and mathematics are outlined.

Prerequisite Competencies in Language

- Aural and reading comprehension needed for the students to be able to learn in the classroom and from tests.
- Reading comprehension and writing skills which enable the students to follow practical exercises, and to write short answers, conclusions, and summaries.
- Reading comprehension and writing skills which enable the students to be assessed.

The reading level required by the student in the learning process is considerable, because subject matter is technical and texts are invariably written in a highly technical style.

This places special demands on the reading skills of the students. However, it is not desirable that students be screened from this technical writing. In order to overcome this situation, a subject titled as 'Industrial Organisation & Communication' has been introduced in Semester I of this Technician course which will enable the students to renew their English comprehension and to cope with technical manuals & documents.

Prerequisite Competencies in Science

- SI System of Units.
  for energy, potential difference, current, time and mass.
  engineering notation: micro, milli, kilo and mega.
- Atomic structure.
  shell theory, groups of elements and covalent bonding electric charge on electron, proton and neutron.
- Electrostatics.
  effect of electric fields on charged particles.
  electric fields around charged bodies.
- Magnetism.
  magnetic fields around magnets and current carrying wires.
  forces on current carrying wires in magnetic fields.

- Conduction of electricity.
  conduction by movement of charge.

- Energy.
  conservation of energy.
  power as rate of change of energy.
  forms of energy: potential, kinetic, work and heat.

Prerequisite Competencies in Mathematics

- Arithmetic.
  fractions, ratios, decimals, and signed arithmetic.
  index notation, number systems and percentages.

- Algebra.
  algebraic expressions, substitution and simplification.
  factorisation and transposition of formulae.
  linear, quadratic and simultaneous equations.

- Geometry.
  degree measurement, angles and geometric shapes.
  Pythagros'theorem.

- Mensuration.
  areas, volumes and the circumference of a circle.

- Trigonometry.
  trigonometry functions, identities and graphs.
  radian measure.

- Graphs.
  rectangular co-ordinates and gradients.
  obtaining information from graphs.

1.1 INDUSTRIAL ORGANISATION & COMMUNICATION — Total 80 hrs

OBJECTIVES

1. Understand the general industrial organisation of a computer manufacturing and marketing company
2. Comprehend the principles of production planning and control in computer industry
3. Be familiar with the quality control procedures in the computer industry
4. Comprehend the elements of costing
5. Adopt industrial safety practices
6. Interpret instructions and procedures given in operating and servicing manuals
7. Be effective and accurate in oral communication with customers and supervisors and maintain cordial relations
8. Be effective in written communication with customers and supervisors
9. Prepare technical reports of servicing and testing
10. Use properly pre-prepared forms for customer calls, assembly, inspection, testing, quality control, indents and stores etc.

1.1 INDUSTRIAL ORGAINISATION AND COMMUNICATION — Total: 80 Hrs

Theory	Hours
1 INDUSTRIAL ORGANISATION	5

Organisation:

Definition, function and operating fundamentals, objectives. Line of supervision & coordination, types of organisation structures, different divisions of an industry and interpersonal relationship with customers, colleagues and supervisors.

Production, Planning and Control: 12

Functions of Production Planning & Control, Overview of manufacturing systems and production procedure, organisation preplanning, product development, sales forecasting & estimating, plant location and layout.

Planning, Brief explanation of production order, process outline process and activity charts, factors determining production levels, machine capacity.

Production control, routing, scheduling & despatching, Computer assisted production control.

Quality Control: 10

Definition of quality, quality product, inspection and quality control, functions of inspection and quality control, customer expectations, Inspection, organisation, operation, metrology, quality control, Basics of statistical quality control, sampling plans, control charts and their uses, quality control standards and specifications adopted in computer industries.

Elements of Costing: 5

Nature and calculation of costs, direct material, direct labour & overhead, sales income, depreciation, basis of depreciation and computation, using cost data, standard cost, compilation of cost for service rendered.

Industrial Safety Practices: 8

Need for safety and safeworking practices, basic principles of accident-prevention, cost of accidents, direct, analysis of unsafe practices and unsafe working condition.

Electrical hazard analysis and identification - Job safety analysis in a computer manufacturing and servicing operation, legal and statutory provision for safety.

II COMMUNICATION 20

Reading:

Comprehension, reading of manuals, scanning and skimming techniques, instruction and interpretation, manual skills according to instruction, note making, preparation of checklist, using checklists.

Speaking:

Mechanics of speech (stress, intonation, rhythm, voice modulation), conversational techniques, audience analysis and appreciation, use of notes, organized talks, display of mastery and confidence, summarising, techniques of participating in group discussions, meetings and attending interviews.

Writing:

Purpose of writing, consideration of formats, selection of content, making notes, developing notes, awareness, sstyle variation, report writing, terms of reference, layout, outlining and initial drafting, proforma reports, variety, reading the forms and structuring the message, choice of information.

TUTORIAL* 16

TEST 4

* Tutorial may include

(1) visits to neighbouring computer manufacturing or servicing industries;

(2) practice sessions for developing oral and written communication.

REFERENCE

1 EFFECTIVE INDUSTRIAL MANAGEMENT

James L Lundy
Macmillan Co New York

2 QUALITY CONTROL

Date H. Besterfield
Prentice Hall inc. New Jersey

3 PRODUCTION PLANNING AND INVENTORY CONTROL

John F. Magee, David M Boodman
McGraw Hill Book Co

4 ACCIDENT PREVENTION MANUAL

American National Safety Council
New York

5 PRACTICAL COMMUNICATION

Harlow, Eric
Longman, London

6 THE BUSINESS OF CUMMUNICATING

Stanton, Nicki
Pan Books, London

7 PEOPLE AND COMMUNICATION

Burton, S.H.
Longman, London.

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 1
Time: 5 Hrs

OBJECTIVE

UNDERSTAND THE GENERAL INDUSTRIAL ORGANISATION OF A COMPUTER MANUFACTURING AND MARKETING COMPANY

SUB OBJECTIVES

1 Be familiar with the types of organisation structure in computer manufacturing company

2 Enumerate the facilitating factors for plant location

3 Prepare suitable layout for production and service centres

4 Understand the functions and interdepartmental procedures

5 Comprehend the need for servicing and maintenance of the products

6 Be familiar with the organisation structure of service section

7 Indentify the roles and functions of the maintenance technician and his superiors.

ASSESSMENT CRITERIA

The student, after visiting a computer manufacturing company, should be able to

i prepare a technical report, projecting the organisation structure, production operations with service functions

ii identify & list the roles and functions of computer technicians

TOPIC

Organisation:

Definition, function and operating fundamentals, objectives, Line of supervision & coordination, types of organisation structures, different divisions of an industry, interpersonal relationships with customers, colleagues and supervisors.

PRACTICAL ACTIVITIES

Visit to computer manufacturing firms.

Prepare organisations charts at the level of the company and of the departments.

REFERNECE

EFFECTIVE INDUSTRIAL MANAGEMENT

James L Lundy Chapters 8,10,16.
Macmillan Co New York

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 2
Time: 12 Hrs

OBJECTIVE

COMPREHEND THE PRINCIPLES OF PRODUCTION PLANNING AND CONTROL IN COMPUTER INDUSTRY

SUB OBJECTIVES

1 Understand the functions of various departments that control and administer the production operations

2 Comprehend the organisation structure of the production planning department and its functions

3 State the importance of production planning activities

4 Be familiar with forecasting methods

5 Indentify various materials with the specification required for manifacturer of a computer.

ASSESSMENT CRITERIA

The student, after a visit, should be able to prepare the following in relevance to a computer manufacturing company:

i forecasting methods
ii process flow chart.

TOPIC

Production, Planning and Control:

Functions of Production Planning & Control, Overview of manufacturing systems and production procedure organisation pre-planning, product development, sales forecasting & estimating, plant location and layout.

Planning, Brief explanation of production order, process outline process and activity charts, factors determining production levels, machine capacity.

Production control, routing, scheduling & despatching, Computer assisted production control.

PRACTICAL ACTIVITIES

From a visit to an industry, gather relevant data and prepare the process flow chart for a computer manufacturing industry.

REFERENCE

EFFECTIVE INDUSTRIAL MANAGEMENT

James L Lundy
Chapter 21
Macmillan Co New York.

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 3
Time: 12 Hrs

OBJECTIVE

BE FAMILIAR WITH THE QUALITY CONTROL PROCEDURES IN THE COMPUTER INDUSTRY

SUB OBJECTIVES

1 State the need for satisfying the customer with quality products

2 Understand the function of quality control department

3 Differentiate the terms 'quality', 'inspection' and 'control'

4 State the need for standardisation to meet customer specifications

5 Enumerate the various techniques used in the process of quality control

6 Diagnose the errors that lead to high rejection rate and scrap level

7 Carry out quality checks at incoming, process control and outgoing points

ASSESSMENT CRITERIA

The student should be able to carry out quality analysis and prepare an action plan to reduce scrap level in a particular section of the industry he visited.

TOPIC

Quality Control:

Definition of quality, quality product, inspection and quality control, functions of inspection and quality control, customer expectations, Inspection, organisation, operation, metrology, quality control, Basics of statistical quality control, sampling plans, control charts and their uses, quality control standards and specifcations adopted in computer industries.

PRACTICAL ACTIVITIES

From a discussion to be held with the Quality Control Department personnel of a Computer manufacturing firm, prepare a detailed report of how the Quality Control is maintained at raw materials, components, sub-assemblies and final product levels.

REFERENCE

QUALITY CONTROL

Date H. Besterfield
Prentice Hall Inc
New Jersey

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 4
Time: 6 Hrs

OBJECTIVE

COMPREHEND THE ELEMENTS OF COSTING

SUB OBJECTIVES

1 Understand the importance of costing

2 Be familiar with the classification of costs

3 List out the methods of computing depreciation

4 Use the relevant cost information data in preparing a bill after attending customer calls.

ASSESSMENT CRITERIA

The student shall prepare a brief report of how the company charges a customer call after servicing.

TOPICS

Elements of Costing:

Nature and calculation of costs, direct material, direct labour & overhead, sales income, depreciation, definition, basis of depreciation and computation, using cost data, standard cost, fixed and variable cost, compilation of cost for service rendered.

PRACTICAL ACTIVITIES

Study the various components that make up for the total cost of a computer product and represent them in percentages and prepare a pie chart.

Study the system of billing made to customer after attending a service call and prepare a bill.

REFERENCE

PRODUCTION PLANNING AND INVENTORY CONTROL

John F. Magee, David M Boodman Chapter 3
McGraw Hill Book Company

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 5
Time: 9 Hrs

OBJECTIVE

ADOPT INDUSTRIAL SAFETY PRACTICES

SUB OBJECTIVES

1 Understand basis of accidents and accident prevention principles

2 Comprehend the cost of accidents

3 Identify the unsafe acts and unsafe conditions

4 Indentify the hazards existing in the working environment

5 Be familiar with statutory requirements related to safety of men and machines

6 Carry out job safety analysis in the operation and servicing of computer and its peripherals.

ASSESSMENT CRITERIA

The student shall prepare a code of safety practices to be followed by servicing & maintenance technicians of a computer industry.

TOPIC

Need for safety and safeworking practices, basic principles of accident-prevention, cost of accidents, direct & indirect, analysis of unsafe practices and unsafe working condition.

Electrical hazard analysis and identification - Job safety analysis in a computer manufacturing and servicing operation, legal and statutory provision for safety.

PRACTICAL ACTIVITIES

Prepare guidelines for safeworking for a computer technician in a production line and in the service department.

REFERENCE

ACCIDENT PREVENTION MANUAL

American National Safety Council
New York.

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION — Learning Unit 6

OBJECTIVE

INTERPRET INSTRUCTIONS AND PROCEDURES GIVEN IN OPERATING AND SERVICING MANUALS

SUB OBJECTIVES

1 Read with comprehension specific set of instructions or procedures

2 Visualize operational sequence and possible problems

3 Scan the manual for appropriate solutions to the problems

4 Check up copmplete adherence to the instructions or procedures.

ASSESSMENT CRITERIA

Given a manual, the student must be able to

1 refer to the required set of instructions/procedures together with their preparatory activities and prepare a check list

2 perform functions in the sequence in which it is suggested

3 display the output of his operations for expository verification.

Example

Before applying power to a new printer, refer to the supplier's operating manual and perform thorough physical check out.

TOPIC

Reading:

Comprehension, reading of manuals, scanning and skimming techniques, instruction and interpretation, manual skills according to instruction, note making, preparation of checklist, using checklists.

Learning Unit 6

PRACTICAL ACTIVITIES

1 Prepare notes after reading short passages of technical matter from text books, manuals etc. and submit to the instructorfor checking comprehension.

2 Prepare a check list of Tasks to be done after reading a set of instructions.

3 Execute tasks according to the Instructions given in the manuals and get them verified by the instructor.

REFERENCE

PRACTICAL COMMUNICATION Pages 98-105

Harlow, Eric
Longman, London.

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 7
Time: 9 Hrs

OBJECTIVE

BE EFFECTIVE AND ACCURATE IN ORAL COMMUNICATION WITH CUSTOMERS AND SUPERVISORS AND MAINTAIN CORDIAL RELATIONS

SUB OBJECTIVES

1 Organize internally the subject matter for oral communication

2 Choose the language that appeals to the audience

3 Speak with full knowledge and confidence

4 Adopt appropriate mechanics of speech in oral communication

5 Watch the nonverbal/verbal response from the audience

6 Emphasise the essence of your speech at the end.

7 Be effective in participating in interviews & group discussions.

ASSESSMENT CRITERIA

Given face-to-face situation with a customer or Supervisor, the student must be able to

i present the required information logically and naturally

ii speak with suitable posture and appropriate tone and tune

iii check the effect of speech with the audience response.

TOPIC

Speaking:

Mechanics of speech (stress, intonation, rhythm, voice modulation), conversational techniques, audience analysis and appreciation, use of notes and graphic aids and organized talks, display of mastery and confidence, summarising, techniques of participating in group discussions, meetings and attending interviews.

Learning Unit 7

PRACTICAL ACTIVITIES

Practice voice modulation and non-verbal cues in speech.

Practice dialogues and participate in small group discussion among the colleagues.

Practice use of set phrases and expressions for interpersonal communication.

REFERENCE

THE BUSINESS OF COMMUNICATING Pages 27-40

Stanton, Nicki
Pan Books, London 1982

PRACTICAL COMMUNICATION Pages 52-58

Harlow, Eric
Longman, London 1967.

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION — Learning Units 8

OBJECTIVE

BE EFFECTIVE IN WRITTEN COMMUNICATION WITH CUSTOMERS AND SUPERVISORS

SUB OBJECTIVES

1 Clarify for oneself the purpose of written communication

2 Decide on the quantity and quality of the necessary information

3 Structure the proposed format

4 Make notes from available sources

5 Write with readability in terms of choice of words and sentence length

6 Adopt suitable style to reach the readers

7 Summarize the writing highlighting the purpose.

8 Use Graphic aids if needed in presenting information.

9 To develop, visualisation and communication skills.

ASSESSMENT CRITERIA

Given a situation to write to customers and supervisors, the student must be able to

1 prepare effective instructions to customers

2 prepare specific forms of communication with supervisors.

Example

Prepare a written instruction for the customer regarding the procedure and precautions in the replacement of ribbon for the printer.

TOPIC

Writing:

Purpose of writing, consideration of formats, selection of content, making notes, developing notes, readability, reader awareness, style variation.

Learning Unit 8

PRACTICAL ACTIVITIES

Making notes from books and develop them into paragraphs.

Compare the readability of chosen written materials and prepare comments.

REFERENCE

PRACTICAL COMMUNICATION Pages 82-88

Harlow, Eric
Longman, London 1967.

1.1 INDUSTRIAL ORGANISATION AND COMMUNICATION

Learning Unit 9
Time: 4 Hrs

OBJECTIVE

PREPARE TECHNICAL REPORTS OF SERVICING AND TESTING

SUB OBJECTIVE

1 Decide on the terms of reference

2 Obtain and arrange necessary material

3 Sift the information

4 Draw the layout

5 Make an outline report

6 Write a fair report.

ASSESSMENT CRITERIA

Given a situation which needs to service an equipment or to test the performance, the student must be able to

i describe on the condition of the equipment and the actual problem faced in using the same

ii organise all the required technical specifications concerned with the equipment

iii write a report on the extent of servicing required of the equipment or on the performances of the equipment.

TOPIC

Report Writing:

Terms of reference, report layout, summarising outlining, initial drafting, preparation of fair report.

PRACTICAL ACTIVITIES

Practice developing formal and informal reports from given hints. Peruse available reports and study the structure, layout etc.

REFERENCE

PRACTICAL COMMUNICATION Pages 117-121

Harlow, Eric
Longman, 1967 London.

1.1 INDUSTRIAL ORGANISATION

Learning Unit 10
Time: 5 Hrs

OBJECTIVE

USE PROPERLY PRE-PREPARED FORMS FOR CUSTOMER CALLS, ASSEMBLY, INSPECTION, TESTING, QUALITY CONTROL, INDENTS AND STORES ETC.

SUB OBJECTIVES

1 Distinguish between various types of forms used for different purposes

2 Be familiar with all the instructions to fill in different forms

3 Select and structure the information required to feed into the forms

4 Process the forms in the appropriate manner.

ASSESSMENT CRITERIA

Given the available forms for reports, the student should be able to

i use appropriate forms for fulfilling the need
ii match the forms with the function performed
iii process the forms for final reporting.

TOPIC

Use of pre-prepared forms:

Selection and use of proper forms for different purposes such as inspection, testing, indents etc.

Reading the forms and proper choice of information and structuring the message.

PRACTICAL ACTIVITIES

Peruse through various types of forms used in Computer manufacturing and servicing and complete the forms with pseudo data.

REFERENCE

PEOPLE AND COMMUNICATION Pages 248-260
Burton, S.H.
Longman, 1980 London.

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES

1.2 ELECTRONIC COMPONENTS, HARDWARE & DEVICES Total 200 Hrs

OBJECTIVES

1 Identify the type of active and passive components that are used in the assembly of electronic circuits and understand their function

2 Interpret the specification and use the devices within their rating

3 Carry out cold AND live tests to check whether electronic component is good or defective

4 Replace defective components and devices with equivalant ones

5 Check the performance of basic electronic circuits and rectify faults if any

6 Mount various types of electronic hardware and make proper connections

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES — Total: 80 Hrs

Theory — Hours

PASSIVE COMPONENTS

Resistors: 5

Fixed resistors, characteristics and rating, specification and size, voltage, power, stability-tolerance, temperature, frequency range, solderability and effect of soldering, shelf life and working life, carbon composition, metal film resistors, cracked carbon resistors, metalic oxide film resistors, cermet resistors, wire wound resisitors, precision resistors, varistors, colour codes, variable resisitors, carbon composition, wire wound, potentio-meters, rheostats, rectilinear and sub minature variable resistors, multiturn potentiometers, different uses of resistors.

Capacitors: 4

Types of capacitors such as paper, tubular and disc ceramic, polyester, mica, tantalum, foil, film, electrolytic, feed through, sizes, mounting techniques, leakage resistance, capacitance, voltage rating, impedance, variable capacitors, trimmer capacitors, temperature, frequency and noise consideration of capacitors.

Inductors: 3

Coils and chokes, constructional features, materials used, size, shapes, ratings and mounting techniques, losses, thermal stability and frequency considerations.

R-L & R-C Circuits: 4

Transients in R.L. & R.C. circuits, series and parallel resonant circuits & crystal oscillator.

Transformers: 5

Types, symbols & codes, constructional features of EHT transformers, output (single ended), pushpull and driver transformers, I.F. interstage, pulse and triggering transformers, ratings, frequency consideration.

ELECTRONIC HARDWARE 9

Type, ratings and mounting techniques, symbols of terminals, plugs, sockets, rotary switch, connectors, device holders (bases), knobs, all types of keys, switches, heat sinks, relays, read relay, speakers, wires and cables, fuses.

ACTIVE COMPONENTS

Diodes: 8

PN junction, forward & reverse bias, characteristics, ratings, juction capacitance, signal and power diodes, half wave & full wave rectifiers, clipping and clamping circuits using diodes.

Zener diodes characteristics, specification, use as a voltage regulator, varactor diode, specification, principle of operation, application.

Thermistors, self and externally heated types, ratings and application, LEDs, LDR, ratings and uses.

Transistors: 12

PNP and NPN transistors, principle of operation, ratings, common base, common emitter and common collector characteristics, classification based on voltage, power and frequency, selection of heat sinks, use as an amplifier.

Field effect transistors: 4

Basic construction of JFET, ratings and characteristics, common source amplifier, common drain or source follower, MOSFET, comparison between MOSFET and JFET, handling precautions and areas of application.

Unijunction transistor & SCR & Photo Transistors:

Constructional details, characteristics, ratings and areas of application, UJT oscillator, SCR as switch and controlled rectifier.

Diacs & Triacs: 3

Characteristics, ratings and application, motor control circuit using Diac and triac.

Cathode Ray Tube: 4

Constructional details, ratings, beam deflection methods, electrostatic and magnetic, picture tubes, handling precautions, focussing and intensity control methods.

Introduction to ICs: 3

Advantages of ICs, type of integrated devices, relative merits, precautions in handling, encapsulation and packages, specifications and testing methods.

TEST 4

REFERENCES

MODERN ELECTRONIC COMPONENTS
GWA Dummer
Pitman & Sons Ltd. London

ELECTRONIC DEVICES AND COMPONENTS
J Seymour
English Language Book Society/Pitman 1984

DEVICES AND CIRCUITS
Millman & Halkias
McGraw Hill International Students Edition

BASIC ELECTRONICS
The English Universities Press Ltd. London

ELECTRONIC DEVICES AND CIRCUITS
Allan Mottershed
Prentice Hall International, USA

Manufacturers Data sheet and Reference manuals for all devices and components of National and International products (Active & passive components).

Manufacturers catalogues giving the dimension of various hardware and their specifications.

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES — Total: 120 Hrs

Practical

The practical activity for this subject must involve study of devices and circuits and aimed to acieve the objectives mentioned under Learning units:

Sl.No.	Activity
1	Various types of resistors
2	Inductors
3	Capacitors
4	I.F. & R.F. transformers
5	A.F. transformers
6	Mains power transformers - variable resistors & potentio-meters
7	Pre set potentio-meters & trimmers
8	Transients in R-L circuits
9	Transients in R-C circuits
10	Series and parallel resonant circuits
	PRACTICAL TEST
11	Switches
12	Connectors & plugs
13	Terminals & sockets
14	Wires and cables
15	Relays
16	Heat sinks
17	Speakers

PRACTICAL TEST

18 Silicon and germanium diodes

19 Halfwave and full wave rectifiers

20 Clipping and clamping circuits

21 Zener diodes

22 Zener voltage regulators

23 Low signal transistors (A-F,I-F,R-F transistors)

24 Thermistors & variators

25 Power tranisitors

26 Common emitter characteristics

27 Common base characteristics

28 Common collector characteristics

PRACTICAL TEST

29 JFETS

30 IGFETS

31 Common source amplifiers

32 Common drain amplifiers

33 UJTS

34 UJT oscillators

35 Photo transistors

36 SCR

37 Diacs & Triacs

38 SCR trigger circuits

39 Simple motor control circuit using Triac

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES

Learning Unit 1
Time: 40 Hrs

OBJECTIVE

IDENTIFY THE TYPE OF THE ACTIVE AND PASSIVE COMPONENTS THAT ARE USED IN THE ASSEMBLY OF ELECTRONIC CIRCUITS AND UNDERSTAND THEIR FUNCTION

SUB OBJECTIVE

1 Identify the resistors of various types such as fixed and variable that are used in electronic circuits

2 Interpret codes printed on passive components, nominal values, ratings and tolerance

3 List the uses of various types of resistors

4 State the working of various types of capacitors and use them within their ratings

5 Indentify the ways in which the inductors are used in filter and resonant circuits

6 State the working of transformers and list their uses

7 Indentify the active component from the type number printed on the device.

ASSESSMENT CRTIERIA

1 Given any passive component, the student must be able to

i) name it and state where it could be used

ii) state the working principle

iii) specify their rating

EXAMPLE

State the various types of capacitors used in electronic circuits and explain their working. List their area of application.

2 Given any active component, the student must be able to refer to the data manual and find the details of the device.

EXAMPLE

Find the type of device specified as AC 127.

Learning Unit 1

TOPICS

Resistors, capacitors, inductors, A.F., R.F., I.F., and power transformers, active components. Sub topics as detailed under the head Theory. Transistor for the subject in R-L, R-C, and R, L, C circuits, resonent circuits

PRACTICAL ACTIVITIES

Study and testing of various type of resistors, inductors, capacitors, I.F., R.F., A.F. and power transformers

Tests on resonant circuits

REFERENCE

MODERN ELECTRONIC COMPONENTS

GWA Dummer
Pitman & Sons Ltd London

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES

Learning Unit 2
Time: 50 Hrs

OBJECTIVE

INTERPRET THE SPECIFICATION AND USE ELECTRONIC DEVICES WITHIN THEIR RATINGS

SUB OBJECTIVES

1 Represent the device by a suitable symbol

2 Sketch the V-I characteristics of the device and state the reasons for the nature of the characteristics

3 Specify the ratings of the given active componets

4 Interpret what each specification means

5 Determine the rating and method of connection of the device from the manual

6 Connect the device properly in the circuit

ASSESSMENT CRITERIA

Given any electronic device, the student must be able to

1 determine its ratings, identify the leads and connect it properly in the circuit using the data manual

2 explain what each rating (specification) means and use the device within its rating

3 sketch its V-I characteristic and explain the reasons for such a curve

Example

1 For the transistor BC 127, determine its rating and lead connection from the manual

2 Sketch the V-I characteristic of an UJT and explain its working.

Learning Unit 2

TOPICS

Various type of diodes, thermistors, LEDs, LDRs, Tranisitors and circuit configuration, Photo transistors, SCRs, Diacs, Triacs, CRTs and deflection methods. Introduction to ICs.

Sub topics are detailed under the head theory for the subject.

PRACTICAL ACTIVITIES

Study and testing of various types of active devices.

REFERENCE

ELECTRONIC DEVICES AND COMPONENTS

J Seymour
English Language Book Society/Pitman 1984

ELECTRONIC DEVICES AND CIRCUITS

Millman & Hill International Students Edition

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES

Learning Unit 3
Time: 30 Hrs

OBJECTIVE

CARRY OUT COLD AND LIVE TESTS TO CHECK WHETHER AN ELECTRONIC COMPONENT IS GOOD OR DEFECTIVE

SUB OBJECTIVES

1 Using a multimeter, check whether the given electronic component or device is good or defective

2 Connect the device with proper biasing and check whether it is working well upto its rating

3 Measure the potentials across the leads of the device when it is in actual circuit and confirm whether it is functioning properly or not.

ASSESSMENT CRITERIA

For any electronic component

1 State the resistance values between the leads that will be obtained under cold check

2 Sketch the type of connection to be made to do the live test

3 State the normal voltages of operation in actual circuit

Example

For the diode BY100,

1 State the forward and reverse resistances

2 Measure its forward voltage drop for its full rated current and also measure leakage current for the rated inverse voltage

3 State the expected voltage drop.

Learning Unit 3

TOPICS

All the active devices listed under learning unit no. 2

PRACTICAL ACTIVITIES

Interpretation of data sheet information and carrying out cold check and live tests as per specification for all active devices listed in Learning Unit 2.

REFERENCE

BASIC ELECTRONICS Books 1 to 5

The English Universities Press Ltd.
London

1.2 ELECTRONIC COMPONENTS HARDWARE AND DEVICES

Learning Unit 4
Time: 20 Hrs

OBJECTIVE

REPLACE DEFECTIVE COMPONENTS AND DEVICES WITH EQUIVALENT ONES

SUB OBJECTIVE

1 Obtain the ratings of the defective device from the values or type no. printed on the device or from the service manuals

2 Select the replacement having ratings equal to or higher than the defective device, referring data manuals

3 Check the circuit for any other fault, other than the device to be replaced

4 Check the performance of the circuit after replacement

ASSESSMENT CRITERIA

Given any defective active or passive components, the student must be able to select suitable alternatives and substitute them in the circuit.

Example

1 An electrolytic capacitor is found to be defective from cold checks. Suggest a suitable alternative.

2 Choose an equivalent for the transistor AC-127

TOPICS

Identification and selection of suitable reference manuals and manufacturer's data sheet for proper information retravial of specifications, ratings, lead connections of various devices and components listed under learning unit 1 and 2. Principles of selecting equivalent devices for each type of device.

PRACTICAL ACTIVITIES

Information retreival from data sheets and manuals choosing equivalents for various devices and substituting and testing in actual circuits.

REFERENCE

MODERN ELECTRONIC COMPONENTS

GWA Dummer
Pitman & Sons Ltd. London

Manuafacturers data sheet and reference manuals for all devices and components of national and International products. (Active & passive components)

1.2 ELECTRONIC COMPONENTS, HARDWARE AND DEVICES

Learning Unit 5
Time: 50 Hrs

OBJECTIVE

CHECK THE PERFORMANCE OF BASIC ELECTRONIC CIRCUITS AND RECTIFY FAULTS IF ANY

SUB OBJECTIVES

Given the simple application circuit of a particular active device

1 State the function of each component used in the circuit

2 List the procedure to check the circuit

3 Carry out d.c. check and test the performance with external signals if required

4 Locate and eliminate faults if any

ASSESSMENT CRITERIA

Given simple application circuits for a diode, transistor or any other active device, certify the circuit performance after eliminating faults if any.

Example

You are given the circuit diagram and the assembled board of a full wave rectifier.

Determine the output of the rectifier and present a performance report.

TOPICS

Half wave and Full wave rectifier circuits:

Clipping and clamping circuits using diodes, Zener diode regulation circuit, LDR and Thermistor circuit, simple transistor amplifier, UJT oscillator, SCR as switch and controlled rectifier, Triac motor control circuit, CRT-circuit.

PRACTICAL ACTIVITIES

Testing all the circuits listed above under the head topic for their working and performance location of simulated or actual faults and eliminating them.

REFERENCE

ELECTRONIC DEVICES AND CIRCUITS

Allan Mottershead
Prentice Hall International, USA.

1.2 ELECTRONIC COMPONENTS HARDWARE AND DEVICES

Learning Unit 6
Time: 10 Hrs

OBJECTIVE

MOUNT VARIOUS TYPES OF HARDWARE AND MAKE PROPER CONNECTIONS

SUB OBJECTIVES

1 Interpret the technical specification of the hardware

2 Measure the dimension of the hardware and drill suitable holes in a chassis and mount it properly

3 Solder the incoming and outgoing cables

4 Check for the proper functioniung of hardware such as switches, relays and speakers etc.

5 Check the continuity and isolation of leads and cables wired to connectors and sockets

6 Handle carefully the various hardwares, interpreting their specifications

ASSESSMENT CRITERIA

Given any hardware, the student must be able to

1 mount and connect it properly with acceptable workmanship

2 state what their rating implies

Example

For the given 22 pin edge connector, specify its rating by referring to Data sheets and mount it on a chassis and solder the leads.

TOPICS

Plugs, sockets, switches, connectors, device holders, knobs, heat sinks, relays, speakers, various types of wire and cable fuses.

PRACTICAL ACTIVITIES

Interpretation of manufacturers data sheets for all types of electronic hardware listed above, checking and testing them for their specification and rating.

REFERENCE

Manufacturers catalogues giving the dimension of various hardware and their specifications.

1.3 BASIC ELECTRICAL ENGINEERING — Total 200 Hrs

OBJECTIVE

1. Select and use proper test equipments such as anmeter, voltmeter and megger
2. Calculate and measure the voltage, current, resistance and power in D.C. circuits
3. Calculate and measure the voltage, current, power factor in AC circuits
4. Comprehend the effects of electromagnetic induction
5. Connect and test single phase and auto transformers
6. Make proper connections to DC and AC motors and run them
7. Test servo and stepper motors
8. Test voltage stabilisers, surge suppressors and isolation transformer for their proper functioning and rectify faults
9. Check the uninterrupted power supply system for its functioning
10. Trace the power distribution system in a computer installation and indentify the distribution equipments and protective devices.
11. Be familiar with codes of practice and safety regulations.

1.3 BASIC ELECTRICAL ENGINEERING Total: 80 Hrs.

Theory Hours

Electrical Instruments: 8

Classification of Electrical measuring instruments, standard symbols, meter accuracy and selection, Moving coil and Moving iron type instruments selection and extension of ranges, linear and non-linear meter scales, ammeters, voltmeters and watt meters, single phase induction type energy meters, multimeters, megger and battery operated solid state insulation resistance measuring instruments, uses of digital instruments in electrical measurments.

D.C.Circuits: 12

Connection methods, Ohm's law, series grouping and parallel grouping of resistors, equivalent resistance of networks, Kirchoff's laws, currents, voltages and power in d.c. circuits with multiple loops and sources, problems relating to calculation of resistance, current, voltage and power in d.c. circuits, principle of working of batteries and their maintenance.

A.C.Circuits:

Single Phase 15

Generation of an alternating emf, alternating current, frequency, peak, RMS and average values, phase relations, effect of resistance, inductance and impedance calculations, current and voltage relations in R-L-C parallel circuits, power and power factor, power factor improvement, Resonant circuits.

Three Phase 5

Reasons for use of three phase circuits, voltage and current relations in balanced star and delta systems, measurement of power and power factor in three phase circuits.

Magnetic Circuits: 7

Magnets and magnetic materials, magnetic field and line of force, properties of various magnetic core materials, B-H curves, Hysteresis and Eddy current losses, Flux density, magnetising force and reluctance in a magnetic circuit, force exerted on a conductor in a magnetic field, Faraday's law of induction, Lenz's law, self and mutual induction in coils, Behaviour of an inductor in AC and DC Cricutis.

Electrical Equipment:

Transformers 6

Function of a transformer, Basic principle of operation, single phase transformers, constructional details, core and shell types, transformer ratings, voltage and current ratios, polarity markings, voltage regulation, load test, auto transformers and their applications.

DC and AC Motors 7

Basic principle of operation of a DC motor, shunt, series and compound motors, connections of field and armature, basic principle of operation of a three phase induction motor, cage and wound rotor constructions, single phase induction motors, split phase, capacitor and shaded pole contructions, universal motors, their applications.

Servo and Stepper Motors 2

Two phase servo motors, drag cup, solid rotor and cage rotor constructions, applications, principle of operation of stepper motors, types of stepper motors, uses of stepper motors in computer peripherals. Brushless motors & linear motors.

Servo controlled voltage stabilisers and Isolating tranformers 3

Function of a servo controlled voltage stabiliser, basic principle of working, voltage regulation, function of an isolating transformer, basic principle of working, their applications.

UPS System: 3

Comparison of stand by supply system and uninterruptible power supply systems, block diagram of an UPS configuration, function of regulated rectifier, battery, static inverter and tranfer system - Applications of UPS systems.

Power distribution system: 8

Single phase and three phase distribution system, electrical equipment in a distribution system of a computer installation, cables, conductors, switching devices, low voltage circuit breakers, types of fuses and their applications, function of a L.V. load relays, necessity of grounding, system and equipment earthing.

TEST 4

REFERENCES

1 ELECTRICAL TECHNOLOGY

H Cotton
Sir Isac Pitman & Sons London

2 ELECTRIC CIRCUITS AND MACHINES

A Mychael
McGraw Hill Book Co. Sydney

3 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS

Robert L Shrader
McGraw Hill Book Co.

4 ELECTRICAL ENGINEERING PRINCIPLES

Stott and Birchall
McGraw Hill Publishing Co. Ltd London

1.3 BASIC ELECTRICAL ENGINEERING Total: 120 Hrs

Practical

The practical activity for this subject must involve study of electrical instruments, circuits and equipment and aimed to achieve the objectives mentioned under learning units.

Sl.No.	Activity
1	Various types of ammeters and voltmeters
2	Multimeters
3	Measurement of insulation resistance using insulation resistance measuring instrument
4	Wattmeters and energymeters
5	Emf sources and testing of batteries
6	Resistance proportionality relationship and measurement of resistance
7	Measurement of currents and voltages in DC series circuits
8	Measurement of currents and voltages in DC parallel circuits
9	Kirchoff's laws
10	Measurement of power in DC circuits
	PRACTICAL TEST
11	Effect of inductance and capacitance in AC circuits
12	Waveforms of currents and voltages in R-L-C circuits
13	Measurement of currents and voltages in series R-L-C circuits
14	Measurement of currents and voltages in parallel R-L-C circuits
15	Measurement of power and power factor in single phase circuits
16	Improvement of power factor in a circuit
17	Testing of resistors, inductors and capacitors
18	Measurement of currents and voltages in balanced star connected systems

Sl.No.	Activity	Total: 120 Hrs

19 Measurement of currents and voltages in a balanced delta connected systems

20 Measurement of power and powerfactor in a three phase system using two wattmeters

PRACTICAL TEST

21 Magnetic field patterns due to permanent and electromagnets

22 Measurement of emfs due to self and mutual induction of coils

23 Behaviour of an inductor in AC and DC circuits

24 Power losses in a magnetic circuit

25 Core and shell type transformer constructions

26 Polarity and ratio tests on single phase transformers

27 Load test on a single phase transformer and determination of its voltage regulation

28 Connection and testing of auto transformers

PRACTICAL TEST

29 Connection and running of DC series, shunt and compound motors

30 Connection and running of three phase cage and wound rotor induction motors

31 Connection and running of split phase, capacitor and shaded pole single phase induction motor

32 Testing and running of universal motor

33 Testing and running of servo motors

34 Identification of coil leads, testing and running of stepper motors by a pulsed voltage source

35 Checking the voltage regulation of servo controlled voltage stabilisers and testing of isolation transformers

36 Checking the UPS system for its functioning

Total: 120 Hrs

Sl.No.	Activity
	PRACTICAL TEST
37	Tracing and drawing the power distribution system of a computer installation
38	Testing of switches and low voltage circuit breakers
39	Testing of overload relays
40	Checking system and equipment grounding and earthing.

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 1
Time: 20 Hrs

OBJECTIVE

SELECT AND USE PROPER TEST EQUIPMENTS SUCH AS AMMETER, VOLTMETER, MULTIMETER AND MEGGER.

SUB OBJECTIVES

1 Distinguish between moving coil and moving iron indicating instruments

2 Measure voltages and currents in AC or DC electrical circuits by selecting the right type of meter and range

3 Measure power in an electrical circuit using wattmeters

4 Interpret the various markings and ranges provided in a multimeter

5 Measure currents, voltages and resistances in an electrical circuit using a multimeter

6 Interpret the name plate details of an energy meter and measure the energy consumption in an electrical system

7 Measure the insulation reisstance of an electrical equipment or a system using insulation resistance measuring instrument

8 Indentify the various types of digital instruments for measuring electrical quantities that are used in practice

ASSESSMENT CRITERIA

1 Given a multimeter, the student must be able to measure currents, voltages and resistances of an electrical circuit

2 Given an insulation resistance measuring instrument, the student must be able to measure the insulation resistance of three electrical systems and comment upon the measurement.

Learning Unit 1

TOPICS

Electrical Instruments:

Classification of Electrical measuring instruments, Standard symbols, meter accuracy and selection, Moving Coil and Moving Iron type instruments, Selection and extension of ranges, Linear and non linear meter scales, ammeters, voltameters and wattmeters, single phase induction type energy meters, multimeters, megger and battery operated solid state insulation resistance measuring instruments, uses of digital instruments in Electrical measurements.

PRACTICAL ACTIVITIES

Practice in the use of ammeters, voltmeters, multimeters, insulation testers, wattmeters, energy meters.

REFERENCE

1 ELECTRICAL TECHNOLOGY, Pages 527-546

H Cotton
Sir Isac Pitman & Sons London

2 ELECTRIC CIRCUITS AND MACHINES, Pages 406-436

A Mychael
McGraw Hill Book Co. Sydney

3 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS, Pages 147-191

Robert L Shrader
McGraw Hill Book Co.

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 2
Time: 30 Hrs

OBJECTIVE

CALCULATE AND MEASURE THE VOLTAGE? CURRENT, RESISTANCE AND POWER IN D.C. CIRCUITS

SUB OBJECTIVE

1 Apply Ohm's law to single loop circuits

2 Distinguish between series and parallel circuits

3 Calculate the equivalent value of resistors connected in series, parallel and series parallel configuration

4 Solve for currents in DC circuits having multiple loops with a single source

5 Apply Kirchoff's laws to circuits having multiple loops and sources

6 Calculate the power dissipation in resistors of DC circuits

7 Measure the currents, voltages and resistance in series and parallel DC circuits

ASSESSMENT CRITERIA

1 Given a resistance network with multiple loops, the student must be able to calculate the currents, voltages and power dissipation in any resistor

2 Given a multimeter, the student must be able to measure the current, voltage and resistance in any DC circuit.

TOPICS

D.C. Circuits:

Connection methods, Ohm's law, series grouping and parallel grouping of resistors, equivalent esistance of networks, kirchoff's laws, currents, voltages and power in d.c. circuits with multiple loops and sources, problems relating to calculation of resistance, current, voltage and power in d.c. circuits. Principle of working of batteries and their maintenance.

Learning Unit 2

PRACTICAL ACTIVITIES

Study of emf sources and vertification of Ohm's law and Kirchoff's law.

Measurement of resistance

Measurement of current voltages and power in series and parallel circuits

Practice Maintenance of batteries.

REFERENCE

1 ELECTRICAL TECHNOLOGY, Pages 41-51

H Cotton
Sir Isac Ptiman & Sons London

2 ELECTRICAL ENGINEERING PRINCIPLES, Pages 91-133

Stott and Birchall
McGraw Hill Publishing Co Ltd London

3 ELECTRIC CIRCUITS AND MACHNINES, Pages 32-65

A Mychael
McGraw Hill Book Co Sydney

4 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS, Pages 1-50

Robert L Shrader
McGraw Hill Book Co

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 3
Time: 50 Hrs

OBJECTIVE

CALCULATE AND MEASURE THE VOLTAGE, CURRENT, POWER FACTOR IN AC CIRCUITS.

SUB OBJECTIVES

1 Interpret the terms amplitude, RMS value, average value and frequency for a given sine wave

2 Record the waveforms of voltages and currents in R-L-C circuits using a CRO

3 Calculate the reactance, impedance and phase angle of the given single phase AC circuit

4 Calculate and measure voltages, currents, power and power factor in series and parallel circuits

5 Distinguish between star and delta connections in three phase circuits

6 Calculate and measure voltages, currents, power and power factor in balanced three phase circuits.

ASSESSMENT CRITERIA

1 Given a single phase circuit, the student must be able to calculate and measure the currents, voltages, power and power factor

2 Given a balanced three phase circuit, the student must be able to calculate and measure the currents, voltages, power and power factor.

TOPICS

A.C. Circuits:

Single Phase: Generation of an alternating emf, alternating current, frequency, peak, RMS and average values, phase relations, effect of resistance, inductance and capacitance in A.C. circuits, reactance and impedance calculations, current and voltage relations in R-L-C parallel circuits, power and power factor improvement.

Three Phase: Reasons for use of three phase circuits, voltage and current relations in balanced star and delta systems, measurement of power and power factor in three phase circuits.

Learning Unit 3

PRACTICAL ACTIVITIES

Measurement of voltages and current and study of waveforms in R-L-C circuits. Measurement of power and power factor in single phase and three phase systems.

REFERENCE

1 ELECTRICAL TECHNOLOGY, Pages 221-282

H Cottob
Sir Isac Pitman & Sons London

2 ELECTRICAL ENGINEERING PRINCIPLES, Pages 165-190

Stott and Birchall
McGraw Hill Publishing Co Ltd London

3 ELECTRIC CIRCUITS AND MACHINES, Pages 205-278

A Mychael
McGraw Hill Book Co Sydney

4 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS, Pages 61-126

Robert L Shrader

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 4
Time: 20 Hrs

OBJECTIVE

COMPREHEND THE EFFECTS OF ELECTROMAGNETIC INDUCTION

SUB OBJECTIVE

1 Interpret the B-H curves of various magnetic materials

2 Observe the pattern of the magnetic fields surrounding permanent magnets

3 Calculate flux density, magnetising force and reluctance in a magnetic circuit

4 List the methods of reducing Hysteresis and Eddy current losses in magnetic circuit

5 Calculate the force exerted on a current carrying conductor in a magnetic field

6 Apply Faraday's law of induction to determine the emf induced in a conductor

7 Measure the emfs due to self and mutual induction in inductive coils

8 Test the behaviour of an inductor with AC and DC power supplies

ASSESSMENT CRITERIA

1 Given a magnetic circuit with dimensions, the student must be able to calculate the flux density, reluctance and magnetising force.

2 Given an electromagnetic system the student must be able to calculate the emf induced in the conductor/coil.

3 Given an inductor, the student must be able to connect it in an electrical circuit and test for its condition.

Learning Unit 4

TOPICS

Magnetic Circuits

Magnets and magnetic materials, magnetic field and lines of force, properties of various magnetic core materials, B-H curves, Hysteresis and Eddy current lossess, Flux density, magnetising force and reluctance in a magnetic, force exerted on a conductor in a magnetic field, Faraday's law of induction, Lenz's law, self and mutual induction in coils, Behaviour of an inductor in AC and DC circuits.

PRACTICAL ACTIVITIES

Study of Inductors in AC & DC circuits. Measurement of emf due to self and mutual inductance in coils

Study of magnetic field patterns due to permanent and electro magnets.

REFERENCES

1 ELECTRICAL TECHNOLOGY Pages 3-40

H Cotton
Sir Isac Pitman & Sons London

2 ELECTRICAL ENGINEERING PRINCIPLES

Stott & Birchall Pages 134-150
McGraw Hill Publishing Co Ltd London

3 ELECTRIC CIRCUITS AND MACHINES

A Mychael Pages 107-135
McGraw Hill Book Co Sydney

4 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS

Robert L Shrander Pages 51-60
271-285

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 5
Time: 20 Hrs

OBJECTIVE

CONNECT AND TEST SINGLE PHASE AND AUTO TRANSFORMERS

SUB OBJECTIVES

1 Interpret the name plate details of a transformer

2 Indentify the various parts of core and shell type tranformers

3 Calculate the primary, secondary voltages and currents in a transformer of given turns ratio

4 Check the correctness of the polarity markings of a single phase transformer

5 Conduct a load test on a single phase transformer to determine its voltages regulation

6 Connect up an auto transformer in an electrical circuit.

ASSESSMENT CRITERIA

1 Given a single phase tranformer, test it on load and determine its voltage regulation

2 Given an auto tranformer, interpret its name plate details and connect up in an electrical circuit.

TOPICS

Transformers:

Function of a tranformer, Basic principle of operation, single phase tranformers, constructional details, core and shell types, transformer ratings, voltage and current ratios, polarity markings, voltage regulation, load test, auto tranformers and their applications.

PRACTICAL ACTIVITIES

Study of core and shell type transformers, polarity and ratio test in a single phase transformers; connection and testing of auto tranformers.

REFERENCES

1 ELECTRIC TECHNOLOGY

H Cotton Pages 279-298
Sir Isac Pitman & Sons London

2 ELECTRIC CIRCUITS AND MACHINES

A Mychael Pages 279-298
McGraw Hill Book Co Sydney

3 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS

Robert L Shrander Pages 365-384
McGraw Hill Book Co

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 6
Time: 20 Hrs

OBJECTIVE

MAKE PROPER CONNECTIONS TO DC AND AC MOTORS AND RUN THEM

SUB OBJECTIVE

1 Identify the armature and field terminals of the given DC motor

2 Connect the given DC motor to supply and check up its performance under running condition

3 Distinguish between a cage and wound rotor three phase induction motors

4 Connect the given induction motor to supply and check its performance under running condition

5 List the various FHP motors used in practice and their applications

6 Connect up the various FHP motors to supply and run them.

ASSESSMENBT CRITERIA

Given electric motors of different types, the student must be able to identify their terminals, connect up to the supply and run them.

TOPIC

DC and AC motors:

Basic principle of operation of a DC motor, shunt, series and compound motors, connections of field and armature, basic principle of operation of a three phase induction motor, cage and wound rotor constructions, single phase induction motors, split phase, capacitor and shaded pole constructions, universal motors, their applications. Elimination of disturbances generated in d.c. motors.

PRACTICAL ACTIVITIES

Connection and running of DC series, shunt and compount motors, three phase induction motors and single phase motors.

REFERENCE

1 ELECTRIC TECHNOLOGY, Pages 130-160, 377-423

H Cotton
Sir Isac Pitman & Sons London

2 ELECTRICAL ENGINEERING PRINCIPLES, Pages 205-214

Stott and Birchall
McGraw Hill Publishing Co London

3 ELECTRIC CIRCUITS AND MACHINE, Pages 170-204
368-380

A Mychael
McGraw Hill Book Co Sydney

4 ELECTRICAL FUNDAMENTALS FOR TECHNICIANS,
Pages 218-233

Robert L Shrader
McGraw Hill Book Co

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 7
Time: 10 Hrs

OBJECTIVE

TEST SERVO AND STEPPER MOTORS

SUB OBJECTIVES

1 List the various types of servo motors and their uses

2 Indentify the difference in rotor construction among the various types of servo motors

3 State the uses of a stepper motor in computer peripherals

4 Interpret the terminal markings and name plate details of a stepper motor

5 Connect up the given stepper motor and check up its performance under running condition

ASSESSMENT CRITERIA

Given a servo motor and a stepper motor, the student must be able to identify the terminal markings, connect up and run and check its condition.

TOPIC

Servo and Stepper Motors:

Two phase servo motors, drag cup, solid rotor and cage rotor constructions, applications, principle of operation of stepper motors, types of stepper motors uses of stepper motors in computer peripherals. Brushless motors and linear motors.

PRACTICAL ACTIVITIES

Testing and running of servo motors and stepper motors

REFERENCE

1 MANUAL OF ELCTRO MECHANICAL DEVICES, Pages 131-133

Doughlas C Grenn Wood
McGraw Hill Book Co

2 CONTROL SYSTEM COMPONENTS, Pages 276-304

John E Gibson & Franz B Tuteur
McGraw Hill Book Co

3 Pamphlets/Information sheets from the manufacturers

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 8
Time: 5 Hrs

OBJECTIVE

TEST VOLTAGE STABILISERS, SURGE SUPPRESSORS AND ISOLATION TRANFORMERS FOR THEIR PROPER FUNCTIONING AND RECTIFY FAULTS

SUB OBJECTIVES

1 Interpret the specifications given on the name plate details of a servo controlled voltage stabiliser

2 Connect up to the supply and check its voltage regulation under varying supply and load conditions

3 Indentify the major faults in a voltage stabilisers and report them

4 State the importance of using isolating transformers in an electrical installation

5 Test an isolating tranformer for its proper functioning

6 Test the operation of a surge suppressor.

ASSESSMENT CRITERIA

Given a voltage stabiliser, the student must be able to connect up to a variable supply and load and determine its voltage regulation for different conditions.

TOPIC

Servo controlled voltage stabilisers and Isolating transformers:

Function of a servo controlled voltage stabiliser, basic principle of working, voltage regulation, function of an isolating tranformers, basic principle of working, their applications.

PRACTICAL ACTIVITIES

Checking the voltage regulation and protective cut off action of servo controlled voltage stabilisers.

Testing of Isolation tranformers.

Learning Unit 8

REFERENCE

1 HAND BOOK FOR ELECTRONICS ENGINEERING TECHNICIANS
Pages 16-1-16-26

Milton Kaufman & Arthur Hesaidman
McGraw Hill Book Co

2 Pamphlets/Information sheets from the manufacturers

1.3 BASIC ENGINEERING
ENGINEERING

Learning Unit 9
Time: 5 Hrs

OBJECTIVE

CHECK THE UNINTERRUPTED POWER SUPPLY SYSTEM FOR ITS FUNCTIONING

SUB OBJECTIVES

1 Distinguish between stand by power supply system and uniterrupted power supply system

2 Indentify the regulated rectifier, battery, static inverter and transfer system in an UPS system

3 Interpret the specifications given in the name plate details of an UPS System.

ASSESSMENT CRITERIA

Given an uninterrupted power supply system, the student must be able to check its functioning.

TOPICS

UPS System:

Comparison of stand by supply system and uninterruptible power supply systems. Block diagram of an UPS configuration, function of regulated rectifier, battery, static inverter and transfer system - Applications UPS systems.

PRACTICAL ACTIVITIES

Check UPS system for its functioning.

REFERENCE

Pamphlets/Information sheets from the manufacturers.

1.3 BASIC ELECTRICAL ENGINEERING

Learning Unit 10

OBJECTIVE

TRACE THE POWER DISTRIBUTION SYSTEM IN A COMPUTER INSTALLATION AND INDENTIFY THE DISTRIBUTION EQUIPMENT AND PROTECTIVE DEVICES

SUB OBJECTIVE

1 Distinguish between single phase and three phase distribution system

2 Trace the power distribution system in a computer installation and draw a line diagram

3 Identify race ways, UG cables, conductors and other electrical equipments in a distribution system

4 Identify the switching devices, low voltage circuit breakers and fuse units in a distribution panel board

5 List the difference types of fuses and their applications

6 Locate the fuse failure in a distribution system and rectify the fault

7 Test a low voltage circuit breaker and check its functioning

8 Check the system grounding and equipment grounding for its effective earthing.

ASSESSMENT CRITERIA

Given the power distribution system of a computer installation, the student must be able to draw a line diagram indicating the various electrical equipments and protective devices.

TOPICS

Power distribution systems:

Single phase and three phase distribution system, electrical equipment in a distribution system of a computer installation, cables, conductors, switching devices, low voltage circuit breakers, types of fuses and their applications, function of a L.V. circuit breaker, over load protection, thermal over load relays, necessity of grounding, system and equipment earthing.

Learning Unit 10

PRACTICAL ACTIVITIES

Tracing and drawing the power distribution system of a computer installation.

Testing of switches and low voltage circuit breakers.

Testing of overload relays.

Checking system and equipment grounding and earthing.

REFERENCES

1 ELECTRIC CIRCUITS AND MACHINES

A Mychael Pages 381-405
McGraw Hill Book Company, Sydney

2 INDUSTRIAL ELECTRICAL SYSTEM

Dale F. Patrick & Stephen W Fardo
Howard W Sams & Co Pages 65-87
Indiana

1.4 WORKSHOP PRACTICE

Total 120 Hrs

OBJECTIVES

1 Use properly all types of hand tools

2 To construct chassis, front panels and cabinets to house electronic equipments, mounting PCBs & sub-assemblies

3 Develop sufficient skills in soldering & desoldering electronic components and hardware

4 Prepare printed circuit boards

5 Adopt safety practices.

1.4 WORKSHOP PRACTICE

Total: 120 Hrs

Practical

Sl.No.	Activity
1	Safety practices - demonstration
2	Demonstration of first aid to shock victims
3	Demonstration of use of various hand tools
4	Sheet metal cutting by guillotine, hand saw and power saw
5	Use of pedestal drill and hand drill
6	Bending of metal sheets
7	Spot and gas welding
8	Filing and fitting
9	Tapping
10	Making chassis
11	Making panels
12	Making cabinets
13	Making racks

PRACTICAL TEST

14	Mounting of various connectors & sockets
15	Soldering with various wattage irons
16	Soldering practice
17	Desoldering practice
18	Soldering with various components, devices, cables and connectors
19	Soldering and desoldering ICs
20	PC board making
21	Assembly of circuits on single sided PCB
22	Repairs to circuits on double sided PCB

Sl.No	Activity
	PRACTICAL TEST
23	Cable harness and cable soldering
24	Wire wrapping
25	Terminating complex connectors & cables
26	Disassembly of transformers & refixing
27	Connecting & disconnecting ribbon cables
	PRACTICAL TEST
28	Projects:

The student must be given projects in sheet metal work and on PCB making, in addition to the above activities and encourages to wire, assemble, fabricate cabinets and panels similar to the following items

i Logic probe
ii Variable power supply
iii Fixed power supply 5V, +12V, -12V
iv Dedicated digital clock

REFERENCES

1 ELECTRONIC MAINTENANCE I
Instructional Manual
Published by
The Egngineering Industry Training Board
54 Clarendon Road
Watford WD 11LB UK

2 ELECTRONICS TECHNIQUES - Shop Practices and Construction

Robert S Villanucci
Prentice Hall Inc

3 BASIC SHEET METAL PRACTICE

J W Giachino
D Van Nostrand Company Inc USA

4 MODULE D.2: THIN PLATE WORKING I & II
for Engineering Craftsman

Publishes by
I.T.B. Engineering Industry Training Boards
140 Tottenham Court Road London W1

5 PRINTED CIRCUIT BOARDS - Design and Technology

Walter C Bosshart Chapter 20
Tata McGraw Hill Pub Co Ltd
New Delhi

6 SAFETY MANUAL

Published by
National Agencies

1.4 WORKSHOP PRACTICE

Learning Unit 1
Time: 15 Hrs

OBJECTIVE

USE PROPERLEY ALL TYPES OF HAND TOOLS

SUB OBJECTIVES

1 Use various hand tools and instruments for sheet metal work and electronic assembly

2 Acquire the skills to handle the tools

3 Observe safety practices in using them.

ASSESSMENT CRITERIA

Given the nature of the job, the student must be able to select suitable tools and handle them safely.

TOPICS

Hand tools and safety practices.

PRACTICAL ACTIVITIES

Demonstration of safety practices

Demonstration of use of various tools.

REFERENCE

ELECTRONICS MAINTENANCE I EITB Module J.4

Instructional Manual, Published by
The Engineering Industry Training Board
54 Clarendon Road
Watford WD 11LB UK

1.4 WORKSHOP PRACTICE

Learning Unit 2
Time: 45 Hrs

OBJECTIVE

MAKE CHASSIS, FRONT PANELS AND CABINETS TO HOUSE ELECTRONIC EQUIPMENTS, MOUNTING PCBs & SUB ASSEMBLIES

SUB OBJECTIVES

1. Given mechanical drawing, select proper tools, instruments and accessories and material for making the required unit
2. Plan the sequence of operations to be done
3. Be familiar with the operation and use of the various machineries required for making the unit
4. Carry out the job with precision, tolerance and finish demanded as per specifications and standards
5. Observe safety precautions.

ASSESSMENT CRITERIA

Given the drawings for sheet metal work, the student must be able to fabricate the unit as per specifications and standards.

TOPICS

Sheet Metal Work:

Interpretation of related drawing, selection of suitable machines and tools, safe working procedures, types of specification and standards.

PRACTICAL ACTIVITIES

Use of machines and tools, fabrication of chassis, panels and cabinets involving cutting, bending, welding, filing, fitting, drilling, tapping etc.

Carry out sheet metal work related to the project chosen

REFERENCES

1 ELECTRONIC TECHNIQUES - Shop Practices & Construction

Robert S Villanucci Chapters 5,6,7 & 8
Prentice Hall Inc

2 BASIC SHEET METAL PRACTICE

J W Giachino
D Van Nostrand Company Inc USA

3 MODULE D.2: THIN PLATE WORKING I & II
For Engineering Craftsman

Published by
I.T.B. Engineering Industry Training Boards
140 Tottenham Court Road London W1

1.4 WORKSHOP PRACTICE

Learning Unit 3
Time: 30 Hrs

OBJECTIVE

DEVELOP SUFFICIENT SKILLS IN SOLDERING & DESOLDERING ELECTRONIC COMPONENTS AND HARDWARE

SUB OBJECTIVES

1 Be familiar with the use of various accessories used for safe soldering & desoldering of electronic components

2 Develop the required competency in the soldering and desoldering of active and passive components and SSI, LSI and VSLI chips and electronic hardware without damaging the devices

3 Inspect soldered joints for quality

4 Observe safety practices

ASSESSMENT CRITERIA

1 Given a job of soldering, the student must be able to carry out the work to an acceptable quality and standard

2 Given a job of replacement, the student must be able to desolder and replace the device without any damage to the board and the device.

TOPICS

Interpretation of data sheets and mounting of various connectors and sockets

Soldering and desoldering of electronic components, devices and hardware as per standards of quality

Procedures and safety practices

Proper handling of CMOS devices.

PRACTICAL ACTIVITIES

Mounting of various connectors, switches, sockets, components and devices

Soldering practice with various wattage soldering irons

Desoldering practice

Learning Unit 3

Use of soldering and desoldering guns

Cable harness and cable soldering

Wire wrapping

Terminating complex connectors and cables

Prepare cables and connectors related to project work

REFERENCES

1 PRINTED CIRCUIT BOARDS - Design and Technology

Walter C Bosshart Chapter 20
Tata Mc Graw Hill Pub Co Ltd
New Delhi

2 ELECTRONICS TECHNIQUES - Shop Practices and Construction

Robert S Villanucci Chapters 12,13 & 14
Prentice Hall Inc. USA

1.4 WORKSHOP PRACTICE

Learning Unit 4
Time: 20 Hrs

OBJECTIVE

PREPARE PRINTED CIRCUIT BOARDS

SUB OBJECTIVES

1 Comprehend the various materials and specifications and equipments, related to the making of printed circuit boards

2 Understand the processes of making PCBs for a given circuit diagram

3 Using photographic processes prepare the PCB as per standard quality

4 Acquire skill in drilling the required holes and assembly of the circuit

5 Observe the necessary safety precautions

ASSESSMENT CRITERIA

Given the printed circuit diagram, the student must be able to prepare the PCB and assemble the circuit to acceptable standards and specification.

TOPICS

Printed circuit boards

Procedures for making PCBs

Selection and use of various materials and equipments

Safety Practices

PRACTICAL ACTIVITIES

Making PCBs for given drawings and printed circuit wiring

Mounting of components and assembly of PCB visual checks for proper interconnection, polarity and leads

Testing of the single assembled circuit

Repairs of single and double sided PCBs

Assemble PCB related project work

REFERENCES

ELECTRONIC TECHNIQUES - Shop Practices and Construction

Robert S Villanucci
Prentice Hall Inc
New Jersey USA

1.4 WORKSHOP PRACTICE

Learning Unit 5
Time: 10 Hrs

OBJECTIVE

ADOPT SAFETY PRACTICES

SUB OBJECTIVES

1 Adopt the safe procedures to handle equipments and peripherals in manually lifting and carrying and dismantling

2 Indentify and list hazards in working with various types of machinery

3 Select appropriate protective clothing, goggles and gloves wherever necessary and use them

4 Check insulation of handles and probes while measuring high voltages & E.H.Ts.

5 Carry out first aid procedures for persons affected by electric shock and other accidents

6 Use fire fighting equipments

ASSESSMENT CRITERIA

The student must practice and adopt safety practices in the work environment and continuously assessed

TOPICS

Safety practices in lifting and transporting and handling materials and equipments

Protective clothing, goggles and gloves

First aid procedures

Handling of fire fighting equipments

PRACTICAL ACTIVITIES

Use of protective clothing, goggles and gloves

Practice measuring high voltages

Practice use of fire fighting equipments

Practice of first aid.

REFERENCES

Safety Manuals published by National Agencies

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs Total: 200 Hrs

OBJECTICES

1 Construct and test simple electronic circuit such as power supply and amplifier

2 Test single stage and multistage amplifier circuits by DC check method

3 Comprehend the operation of oscillators

4 Understand the working of the circuits which use special devices like UJT, FET, SCR and Opto-coupler

5 Assemble and test power supplies using ICs for different voltage and current ratings

6 Assemble and test OP-AMP circuits like amplifier, comparator and timer, function generator ICs

7 Choose appropriate active devices by referring to data sheets.

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs — Total: 80 Hrs

Theory	Contents	Hours
DC Power Supply:		10

Rectifier anf filter circuits, zener diode regulator, series regulator using transistor, feedback regulator, current limiting, load line regulations.

Transistor amplifiers and oscillators — 25

Common base, Common emitter and common collector amplifiers, Approximate values of input and output impedances, current and voltage gains of different configuration, Quiescent point and load line for common emitter amplifier.

Fixed resistance bias, collector to base bias, voltage divider bias with emitter resistance.

Phase relationship between input and output, Fequency response for common emitter amplifier, negative feedback amplifier, Darlington connection, multistage amplifier.

Push-Pull class B power amplifier, complementary Symmetry Power Amplifier, heat sink mounting.

Transistor as switch

Oscillators:

Oscillator principle, LS Oscillators, Hartley and Colpitts Oscillator, RC Oscillators, Phase shift and Wein bridge Oscillators, Crystal Oscillators.

Principles of equivalent substitution of active component by referring manuals.

Industrial devices: — 16

Frequency response of FET amplifier, MOSFET and applications of FETs.

UJT relaxation Oscillator, SCR triggering circuit, DC voltage control using SCR. Typical diac triac phase shift control circuit, applications of Opto coupler.

Voltage Regulator ICs: — 10

Fixed, variable dc power supply circuits using ICs, Dual tracking, foldback current limit.

Switched mode power supply, External testing.

Op amp and function generator ICs: 15

Op amp characteristics, inverting and noninverting amplifiers, voltage follower, comparator, summing and difference amplifier, Differentiator and integrator, multivibrator circuits, various Op amp specifications.

Timer, VCO and function generator ICs.

TESTS 4

REFERENCES:

1 ELECTRONIC DEVICES AND CIRCUITS

Chapter 2,3,11,12,14,15,16,18,19,21,27,28.
Alan Mottorshed
Prentice Hall

2 LINEAR IC MANUAL

National Semiconductors

3 SWITCHED MODE POWER SUPPLY

Suppliers Manual

4 USING DIGITAL AND ANALOG INTEGRATED CIRCUITS

L W Shacklette & H A Ashworth
Prentice Hall, Page 127-198.

5 IC MANAUL OF DIFFERENT MANUFACTURERS

2.1 ELECTRONIC CIRCUIT AND LINEAR ICs Total: 120 Hrs

Practical

Sl.No.	Activity
1	Construction and testing of Half wave and Full wave rectifier with capacitance filter and LC filter.
2	Construction and testing of the DC regulated power supply using Zener diode.
3	Construction and testing of series regulated DC power supply.
4	Construction and testing of feedback regulated DC power supply with current limiting.
5	Study of common emitter amplifier biasing and gain.
6	Study of common emitter amplifier impedance, power and phase relationships.
7	Trouble shooting of a CE amplifier.
8	Construction and testing of Emitter follower.
9	Study of load line analysis of a transistor amplifier.
10	Construction and testing of 2 stage amplifier.
11	Construction and testing of feedback amplifier.
12	Construction and testing of complementary symmetry amplifier.
13	Trouble shooting audio amplifier Practice with replacement of component and testing the performance.

PRACTICAL TEST

14	Study of Hartley and Colpitts Oscillator.
15	Construction and testing of Phase shift oscillator.
16	Construction and testing of Wien bridge oscillator.
17	Construction and testing of crystal oscillator.
18	Construction and testing of UJT relaxation Oscillator.
19	Study of SCR triggering circuit using UJT.
20	Study of DC motor control using SCR.

21 Construction and testing of signal transmission using opto coupler.

22 Construction and testing of 2-7V dc power supply using IC 723

23 Construction and testing of 7-30V dc power supply using IC 723.

24 Construction and testing of +5v, 750mA dc power supply using 7805.

25 Construction and testing variable positive voltage power supply using LM 317.

26 Construction and testing of variable negative voltage power supply using LM 337.

PRACTICAL TEST

27 Construction and testing of Inverting Amp, non-inverting amp, voltage follower and comparator circuit using 741.

28 Study of op amp characteristics.

29 Study of differentiator and Integrator using 741.

30 Construction and testing of op amp multivibrator circuits using 741.

31 Construction of astable and monostable multivibrator using timer IC 55.

32 Study of VCO IC 566 circuit.

33 Study of function generator IC circuit.

34 Study and testing of switched mode power supply.

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs

Learning Unit 1
Time: 40 Hrs

OBJECTIVE

CONSTRUCT AND TEST SIMPLE ELECTRONIC CIRCUIT SUCH AS POWER SUPPLY AND AMPLIFIER.

SUB OBJECTIVES

1 Construct a dc power supply with filter to be operated from ac mains supply and test it for performance.

2 Test the regulated dc power supply using Zener diode and transistor.

3 Explain the amplifying mechanism in a transisitor.

4 Define bias and quiescent collector current.

5 Construct and test RC coupled amplifier using transistor.

ASSESSMENT CRITERIA

1 Given the required voltage and current rating of the dc power supply to be operated from ac mains, the student should be able to

i) choose the appropriate components

ii) construct and test for its performance

Example

Construct 6V, 500 mA dc power supply

2 The student should be able to construct and test single stage class A amplifier.

Example

Using BC 148, construct the single stage Class A amplifier with proper biasing. Check the Quiescent condition and the operation of the amplifier.

TOPIC:

DC Power supply:

Rectifier and filter circuits, zener diode regulator, series regulator using transistor, feedback regulator, current limiting, load and line regulations.

Transistor amplifiers:

Common base, common emitter and common collector amplifiers, differential amplifiers, apporoximate values of input and output impedances, current and voltage gains of different configuration, quiescent point load line for common emitter amplifier.

Fixed resistance bias, collector to base bias, voltage divider bias with emitter resistance.

PRACTICAL ACTIVITIES:

Construction and testing of half wave and full wave rectifier with capacitance filter and LC filter.

Construction and testing of the DC regulated power supply using Zener diod.

Construction and testing of series regulated DC power supply.

Construction and testing of feedback regulated DC power supply with current limiting.

Study of common emitter amplifier biasing and gain.

Study of load line in a transistor amplifier.

REFERENCE

ELECTRONIC DEVICES AND CIRCUITS
Chapter 2,3,11,12

Alan Mottorshed
Prentice Hall

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs

Learning Unit 2
Time: 40 Hrs

OBJECTIVE

TEST SINGLE STAGE AND MULTISTAGE AMPLIFIER CIRCUITS BY DC CHECK METHOD

SUB OBJECTIVES

1 Know the approximate values of the input impedance, output impedance, current gain and voltage gain of the three configurations.

2 Choose the appropriate bias circuit.

3 Understand the different types of feedback circuits.

4 Analyse ac coupled multistage amplifier circuits for operation.

5 Test the performance of amplifier.

ASSESSMENT CRITERIA

Given an ac coupled multistage amplifier circuit, the student should be able to

i) test the circuit by dc voltage check method

ii) correct the circuit by replacing the defective component.

Example

Rectify the fault in a two stage RC coupled amplifier or transformer coupled amplifier and test its performance.

TOPIC:

Transistor amplifiers:

Phase relationship between input and output in a transistor amplifier.

Frequency response for common emitter amplifier, negative feedback amplifier, Darlington connection, multistage amplifier.

Push-pull class B power amplifier, complementary symmetry power amplifier, heat sink mounting.

Transistor as switch.

Learning Unit 2

PRACTICAL ACTIVITIES

Study of common emitter amplifier impedance, power and phase relationships.

Trouble shooting of a CE amplifier.

Construction and testing of Emitter follower.

Construction and testing of 2 stage amplifier.

Construction and testing of Feedback amplifier.

Construction and testing of complementary symmetry amplifier.

Trouble shooting sudio amplifier.

REFERENCE

ELECTRONIC DEVICES AND CIRCUITS
Chapter 14,15,16,19.

Alan Mottorshed
Prentice Hall

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs

Learning Unit 3
Time: 15 Hrs

OBJECTIVE

COMPREHEND THE OPERATION OF OSCILLATORS

SUB OBJECTIVES

1 Understand the conditions required for oscillation.

2 Explain the working of Hartley and Colpitts Oscillators.

3 Analyse the Phase shift oscillator circuit.

4 Construct simple crystal oscillator circuit.

ASSESSMENT CRITERIA

Given any sinusoidal oscillator circuit, the student should be able to comprehend the working of the circuit.

TOPIC:

Oscillator

Oscillator principle, IC Oscillators, Hartley and Colpitts Oscillator, RC oscillators, phase shift and Wien bridge oscillators, crytal oscillator.

PRACTICAL ACTIVITIES:

Study of Hartley and Colpitts Oscillator

Construction and testing of Phase shift oscillator
Construction and testing of Wein bridge oscillator
Construction and testing of Crystal oscillator.

REFERENCE

ELECTRONIC DEVICES AND CIRCUITS

Chapter 18

Alan Mottorshed
Prentice Hall

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs

Learning Unit 4
Time: 35 Hrs

OBJECTIVE

UNDERSTAND THE WORKING OF THE CIRCUITS WHICH USE SPECIAL DEVICES LIKE UJT, FET, SCR AND OPTO-COUPLER

SUB OBJECTIVES

1 Construct and test the UJT relaxation oscillator circuit for a given frequency.

2 Construct a simple dc motor control circuit using SCR

3 List the advantages of using FET as switch and amplifier.

4 Test the simple opto coupler signal transmission circuit.

ASSESSMENT CRITERIA

Given a dc motor control circuit using SCR, measure the voltages and wave forms at different test points.

TOPIC

Industrial devices:

Frequency response of FET amplifier, MOSFET and application of FETs, UJT relaxation oscillator, SCR, typical diac triac phase shift control circuit, applications of Opto coupler.

PRACTICAL ACTIVITIES:

Construction and testing of UJT relaxation oscillator.

Study of SCR triggering circuit using UJT.

Study of DC motor control using SCR.

Construction and testing of signal transmission.

Using Opto coupler.

REFERENCE

ELECTRONIC DEVICES AND CIRCUITS
Chapters 21,27,28

Alan Mottorshed
Prentice Hall

2.1 ELECTRONIC CIRCUIT AND LINEAR ICs

Learning Unit 5
Time: 35 Hrs

OBJECTIVE

ASSEMBLE AND TEST POWER SUPPLIES USING ICs FOR DIFFERENT VOLTAGE AND CURRENT RATINGS

SUB OBJECTIVES

1 Construct variable dc voltage power supply using IC 723.

2 Assemble and test +5V DC, MA fixed voltage power supply using IC 7805.

3 Know the limitations of fixed and variable voltage regulators available.

4 Check the working of switched mode power supply.

5 Recognise and rectify common faults in power a supply.

ASSESSMENT CRITERIA

1 For a given voltage and current rating, the student should be able to construct and test the IC regulated power supply.

Example

Using LH 317, construct a variable DC voltage power supply between 12 and 15 V with the current rating 250 mA.

2 Locate the faults in a switched mode power supply unit.

TOPIC

Fixed, variable dc power supply circuits using ICs, dual tracking, fold back current limit.

DC-DC converters.

Switched mode power supply, safety procedures to be followed.

PRACTICAL ACTIVITIES

Construct and testing of 2-7V dc power supply using IC 723.

Construction and testing of 7-30V dc power supply using IC 723.

Learning Unit 5

Construction and testing of +5V, 750 MA dc power supply using 7805.

Construction and testing of variable positive voltage power supply using LM 317.

Construction and testing of variable negative voltage power supply using LM 337.

Study and testing of switched mode power supply.

REFERENCE

1 LINEAR IC MANUAL

National Semiconductors

2 SWITCHED MODE POWER SUPPLY

Suppliers manual

2.1 ELECTRONIC CIRCUIT AND LINEAR ICs

Learning Unit 6
Time: 30 Hrs

OBJECTIVE

ASSEMBLE AND TEST OP AMP CIRCUITS LIKE AMPLIFIER, COMPARATOR AND TIMER, FUNCTION GENERATOR ICs.

SUB OBJECTIVES

1 Interpret the specifications of op amp

2 Assemble and test inverting amplifier, voltage follower and comparator circuits using IC 741.

3 Comprehend the differentiator and integrator circuits.

4 Test timer, VCO and function generator ICs.

ASSESSMENT CRITERIA

Given a simple op amp circuit or any other linear IC, the student should be able to assemble and test the circuit for its performance.

Example

Construct a multivibrator circuit and test the same, measuring the pulse repetition rate.

TOPIC

Op amp and function generator ICs:

Op amp characteristics, inverting and noninverting amplifiers, voltage follower, comparator, summing and difference amplifier, differentiator and integrator, multivibrator circuits, various Op amps specifications.

Timer, VCO and function generator ICs.

PRACTICAL ACTIVITIES

Construction and testing of inverting amp, noninverting amp, voltage follower and comparator circuit using 741.

Study of Op amp characteristics.

Study of differentiator and integrator using 741.

Construction and testing of Op amp multivibrator cicruits using 741.

Construction of astable and mononstable multivibrator using timer IC 555.

Study of VCO IC 566 circuit.

Study of function generator IC circuit.

REFERENCE

Using Digital and Analog Integrated Circuits

L W Shacklette & H A Ashworth
Prentice Hall, Page 127-198.

2.1 ELECTRONIC CIRCUITS AND LINEAR ICs

Learning Unit 7
Time: 5 Hrs

OBJECTIVE

CHOOSE APPROPRIATE ACTIVE DEVICES BY REFERRING TO DATA SHEETS.

SUB OBJECTIVES

1 Understand the function of any device or linear IC from the data sheet.

2 Interpret the specification given in the data sheet.

3 Replace the defective device with the new device.

ASSESSMENT CRITERIA

The student should be able to

i) check the circuits containing faulty ICs

ii) interpret the specifications of the ICs in the data sheets

iii) replace defective devices with the new IC or its equivalent.

TOPIC

Principles of equivalent substitution of active component by referring manuals.

PRACTICAL ACTIVITIES

Substituting active device like diodes, transistors by referring manuals and testing the circuit for performance.

REFERENCE

IC MANUAL OF DIFFERENT MANUFACTURERS

2.2 DIGITAL ELECTRONIC AND TEST EQUIPMENT Total: 200 Hrs

OBJECTIVES

1 Understand and test basic logic gates for their input-output characteristics with simple input signal circuit and output display circuit

2 Given a problem, specify Boolen expression and from simplified Boolean expression, construct the logic circuit using gates

3 Select and use appropriate digital ICs for simple application circuit

4 Understand the operation and use of RAM and ROM

5 Comprehend the function and choose suitable A/D and D/A converter for the given application

6 Comprehend different number systems, codes and Binary arithmetic

7 Select and use logic probe, oscilloscope. DMM. pulse generator and frequency counters in testing digital circuits.

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS Total: 80 Hrs

Content	Hrs

Test Equipment: 10

Operation, specification and applications of digital multimeter, logic probe and logic pulser and pulse generator.
Oscilloscope - input coupling, trigger controls, probes, delayed time base, multiple trace and application.
Logic analyser fundamentals, selection of suitabable test equipment for the enviroment.

Digital Logic Gate Characteristics and Interfacing: 10

Binary code, binary system, basic logic gates, and, or, inverter, nand, nor, ex-or gates, logic family characteristics, TTL logic gate characteristics, TTL internal circuitry, important points to be remebered in building circuits using TTL, open collector TTL, three state output logic families, CMOS. points to be remebered when working with CMOS, input signal conditioning and signal sources, output signal handling, interfacing logic families to one another, interfacing logic gates to simple displays and relays.

Combinational Logic, and Codes 6

Combining logic gates, Boolean algebra, DeMorgan's theorem, simplification of logic functions, karanaugh map, synthesizing simple logic gate circuits, switches.

Binary Based Codes: 5

Binary, coctal, hexa decimal, BCD code, Gray code. seven segment display code, parity bit, ASCII.

Sequential Logic: 25

NAND latch, RS, latch with enable, D latch, D flip flop. JK flip flop. JK flip flop timing diagrams, IC Ripple Counters, Mod N Counters, applications of ripple counters, synchronous counters, updown counter, shift registers, serial in serial out, serial in parallel out operations, ring counter, parallel in serial out, parallel in parallel out operations, ICs for above functions, multiplexers, demultiplexers, 8 bit latches, bidirectional buffers, decoders and encoders.

Read Write and Read only Memories: 6

Random access memory TTL RAMS, static MOS RAMS, CMOS RAMS, Non volatile RAMS, dynamic MOS RAMS, refreshing a dynamic RAM, available ICs, read only memory, ROM structure and addressing, ROM applications and available ICs.

D/A and A/D converters: 9

Addition, subtraction, arithmetic logic unit, multiplication, division, fixed point and floating point nos.

TEST 4

REFERENCE

1 MICROPROCESSORS AND DIGITAL SYSTEMS

Hall
McGraw-Hill

2 TTL AND CMOS IC MANUALS

3 DIGITAL COMPUTER FUNDAMENTALS

Bartree
McGraw-Hill

4 DIGITAL COMPUTER FUNDAMENTALS

Malvino
McGraw-Hill

5 MEMORY IC MANUAL

6 A/D AND D/A CONVERTER IC DATA SHEETS

7 DIGITAL AND ANALOG INTEGRATED CIRCUITS

L W Shacklette &
H A Ashworth
Prentice Hall

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS Total: 120 Hrs

PRACTICAL

Sl.No	Activity
1	Testing of OR, AND, NOT, NOR, NAND and EX-OR gates
2	Construction and Testing of simple debouncing switch and ILED output circuit
3	Testing TTL input and output characteristics
4	Testing CMOS input and output characteristics
5	Verification of DeMorgan's theorem
6	For a given problem, construction and testing of logic circuit - I
7	Fir a given problem, construction and testing of logic circuit - II
8	Testing of open collector logic, buffer, tristate logic and schmitt trigger using 7406, 74125, 7439, 4050, 7414
9	Construction and testing of clock using 555 and 4707, pulse circuit using 74121
10	Testing of relay driver circuit
11	Testing of single digit seven segment display
12	Testing RS-FF, RST-Flip flops using basic gates
13	Testing JK, FF, D-FF using 7473, 7474, 7476, 4013 and 4027
14	Practice of use with digital multimeter, logic probe and pulse generator
15	Practice of use with oscilloscope
16	Construction and testing of decoder and display circuit using 7447 and common anode seven segment display
17	Construction and testing of decoder and display circuit using 4511 and common cathode seven segment displays
18	Construction and testing of 2 digit and 4 digit binary counter using JK FF
19	Construction and testing of down counter using FF
20	Construction and testing of Modulo n counters using FF
21	Construction and testing of decade counter using 7490 and 4518

22 Construction and testing of divide by n counter

23 Construction and testing of 4 stage serial in parallel out shift register operation using FF

24 Construction and testing of Ring counter and shift counter using FF

25 Testing universal shift register 74194

PRACTICAL TEST

26 Construction and testing of single digit display system

27 Construction and testing updown presettable counter using 74192

28 Testing of different multiplexer and demultiplexer ic's

29 Testing of decoder IC 74138 and 74156

30 Testing of 8 bit latch like 74343

31 Testing of 8 bit bidirectional buffer IC Practice of use with logic analyser

32 Testing of encoder 7414 and 740922

33 Construction and testing of half adder

34 Construction and testing of full adder

35 Testing of 4 bit adder using 7483

36 Testing of arithmetic and logic unit IC 74181

37 Testing of memory IC 74189

38 Testing of DAC 08

39 Testing ADC 0808

40 Testing of seven segment display devices.

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS Learning Unit 1
Time: 30 Hrs

OBJECTIVE

TEST BASIC LOGIC GATES FOR THEIR INPUT-OUTPUT CHARACTERISTICS WITH SIMPLE INPUT SIGNAL CIRCUIT AND OUTPUT DISPLAY CIRCUIT

SUB OBJECTIVES

1 Convert decimal numbers to binary and binary numbers to decimal

2 Construct the truth table for OR, AND, NOT, NOR, NAND and EX-OR gates

3 Use manufacturer's data sheets to determine the input and output voltages and current, and the propagation delay for TTL and CMOS ICs

4 Build simple input signal circuit and output LED or relay circuit.

ASSESSMENT CRITERIA

The student should be able to test the simple logic gates for the specifications with input signalling circuit and output LED circuit.

Example

Construct simple debouncing switch and LED output circuit and test the NAND gate for its truth table.

TOPIC

Digital logic gate characteristics and interfacing:

Binary code, binary system, basic logic gates, AND, OR, inverter, NAND, NOR, EX-OR gates, Logic family characteristics, TTL logic gate characteristics, TTL internal circuitry, important points to be remembered in building circuits using TTL, open collector TTL, three state output logic, TTL subfamilies, MOS logic families, CMOS, points to be remembered when working with CMOS, input signal conditioning and signal sources, output signal handling, interfacing logic gates to simple displays and relays.

PRACTICAL ACTIVITY

Testing of OR, AND, NOT, NOR. NAND and EX-OR gates

Learning Unit 1

Construction and testing of simple debouncing switch and LED output circuit

Testing TTL input and output characteristics

Testing CMOS input and output characteristics

Testing of open collector logic, buffer, tristate logic and schmitt trigger using 7406, 74125, 7439, 4050, 7414

Construction and testing of clock using 555 and 4047, pulse circuit using 74121

Testing of relay driver circuit

Testing of single digit seven segment display.

REFERENCES

1 MICROPROCESSORS AND DIGITAL SYSTEMS

Chapter 2
Hall
McGraw-Hill

2 TTL AND CMOS IC MANUALS

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS

Learning Unit 2
Time: 15 Hrs

OBJECTIVE

GIVEN A PROBLEM, SPECIFY BOOLEAN EXPRESSION AND FROM SIMPLIFIED BOOLEAN EXPRESSION, CONSTRUCT THE LOGIC CIRCUIT USING GATES

SUB OBJECTIVES

1 Comprheend the fundamental concepts, rules and theorems of Boolean Algebra

2 Construct the truth table for a given problem

3 Carry out the simplification procedure

4 Select and interconnect the appropriate logic gates for the given Boolean expression.

ASSESSMENT CRITERIA

For a given problem, the student should be able to

i) write the Boolean expression

ii) simplify the Boolean expression

iii) realize the function by interconnecting the gates

Example

Given a Boolean expression and simplify if possible, contract and test the circuit with basic logic gates.

TOPICS

Combination logic and codes:

Combining logic gates, Boolean algebra, DeMorgan's theorem, simplification of logic functions, karnaugh map, synthesizing simple logic gate circuits, ICs for above functions.

PRACTICAL ACTIVITY

Verification of DeMorgan's theorem

For a given problem, construction and testing of logic circuit - I

For a given problem, construction and testing of logic circuit - II

REFERENCES

1 MICROPROCESSOR AND DIGITAL SYSTEMS

Chapter 3
Hall
McGraw-Hill

2 DIGITAL COMPUTER FUNDAMENTALS

Chapter 3 & 5
Bartee
McGraw-Hill

3 DIGITAL COMPUTER ELECTRONICS

Chapter 2, 3 & 5
Malvino
McGraw-Hill

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS

Learning Unit 3
Time: 90 Hrs

OBJECTIVE

SELECT AND USE APPROPRIATE DIGITAL ICs FOR SIMPLE APPLICATION CIRCUIT

SUB OBJECTIVES

1. Construct the truth tables for the D flip flop, JK flip flop and T flip flop
2. Draw the output timing diagram for a 4 bit binary or any modulo counter
3. Use a schematic diagram to explain the operation of a digital clock
4. Construct shift register using flip flops
5. Draw circuits for a multiplexer and a demultiplexer used to transmit several signals on a single wire
6. Wire the circuit to decode any state of a counter
7. Test the various types of ICs available for different functions such as flip flops, counters, decoders, multiplexer and shift registers.

ASSESSMENT CRITERIA

For a given problem, the student should be able to

i) draw the circuit
ii) choose the appropriate ICs
iii) construct and test the circuit

Example

Construct a single digit display system consisting of counter, latch, decoder and driver display

TOPICS

Flip flops, counters and registers clocks.

NAND latch, RS latch with enable, D latch, D flip flop, JK flip flop, JK flip flop timing diagrams, IC ripple counters, MOD n counters, applications of ripple counters, synchronous counters, updown counter, shift registers, serial in serial out, parallel in serial out operations ring counter, parallel in serial out, parallel in parallel out operations, ICs for above functions, multiplexers, demultiplexers, 8 bit latches, bidirectional buffers, decoders, encoders.

Learning Unit 3

PRACTICAL ACTIVITY

Testing RS-FF, RST-flip flops using basic gates

Testing JK FF, DF-FF using 7473, 747, 7476, 4013 and 4027

Construction and testing of decoder and display circuit using 7447 and common anode seven segment displays

Construction and testing of decoder and display circuit using 4511 and common cathode seven segment displays

Construction and testing of 2 digit and 4 digit binary counter using JK FF

Construction and testing of down counter using FF

Construction and testing of modulo n counters using FF

Construction and testing of decade counter using 7490 and 4518

Construction and testing of divide by n counter using 7490 and 4017

Construction and testing of 4 stage serial in parallelout shift register operation using FF

Construction and testing of ring counter and shift counter using FF

Testing universal shift register 74194

Construction and testing of single digit display systesm

Construction and testing of updown presettable counter using 74192

Testing of decoder IC 74138 and 74156

Testing of different multiplexer and demultiplexer like 74150 and 740922

Testing of encoder 74148 and 740922

Testing of 8 bit latches like IC 74343

Testing of 8 bit bidirectional buffer IC.

REFERENCES

1 MICROPROCESSORS AND DIGITAL SYSTEMS

Chapter 3, 4
Hall
McGraw-Hill

Learning Unit 3

2 DIGTIAL COMPUTER FUNDAMENTALS

Chapter 4
Bartee
McGraw-Hill

3 DIGITAL COMPUTER ELECTRONICS

Chapter 7, 8
Malvino
McGraw-Hill

4 TTL AND CMOS IC MANUALS

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS Learning Unit 4
Time: 15 Hrs

OBJECTIVE

UNDERSTAND THE OPERATION AND USE OF RAM AND ROM

SUB OBVJECTIVES

1 Describe matrix orgainisation and addressing of a RAM/ROM

2 Given a data sheet for RAM, find the important timing parameters for read and write operations

3 Describe difference between static and dynamic MOS RAM

4 Describe the programming and erasing of a typical EPROM or EEPROM

ASSESSMENT CRITERIA

Given a static RAM chip, the student should be able to refer to the data sheet and test its function

Example

Test the memory IC 74189

TOPICS

Read Write Memories:

Random access, TTL RAMS, Static MOS RAMS, CMOS RAMS, Non volatile RAMS, Dynamic MOS RAMS, Refreshing a dynamic RAM, available ICs.

Read only memory, ROM structure and addressing, ROM applications, available ICs.

PRACTICAL ACTIVITIES

Testing of memory IC 74189

REFERENCES

1 MICROPROCESSORS AND DIGITAL SYSTEMS

Chapter 5, 2
Hall
McGraw-Hill

Learning Unit 4

2 DIGITAL COMPUTER FUNDAMENTALS

Chapter 6
Bartee
McGraw-Hill

3 DIGITAL COMPUTER ELECTRONICS

Chapter 9
Malvino
McGraw-Hill

4 MEMORY IC MANUAL

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENTS

Learning Unit 5
Time: 15 Hrs

OBJECTIVE

COMPREHEND THE FUNCTION AND CHOOSE SUITABLE A/D AND D/A CONVERTER FOR THE GIVEN APPLICATION

SUB OBJECTIVES

1 Draw the circuit for an R-2R ladder-type D/A converter and describe its operation

2 Define the terms used to describe D/A and A/D converters such as resolution, accuracy, linearity and conversion time

3 Draw a block diagram and describe the operation of the parallel type A/D, the single-ramp A/D, the dual-ramp A/D, the counter type A/D, the tracking A/D and the successive approximation A/D converter

4 Test the A/D converter and D/A converter ICs for its performance.

ASSESSMENT CRITERIA

For a given problem, the student should be able to

i) choose the appropriate A/D or D/A converter IC
ii) wire the circuit and test it.

Example

Construct a A/D converter IC circuit for 8 bit accuracy with the maximum input of 5V.

TOPICS

D/A and A/D converters:

Digital to analog converter
Binary weighted resistor D/A converter
R/2R ladder D/A converter
Monolithic and Hybrid D/A converter
Analog to digital converter
Parallel comparator, single ramp, dual slope,
A/D converters using counters and D/A converters
Successive approximation A/D converters, available ICs

PRACTICAL ACTIVITY

Testing of DAC 08

REFERENCES

1 MICROOPROCESSORS AND DIGITAL SYSTEMS

Chapter 6
Hall
McGraw-Hill

2 DIGITAL COMPUTER FUNDAMENTALS

Chapter 7
Bartee
McGraw-Hill

3 A/D AND D/A CONVERTER IC DATA SHEETS

2.2 DIGITAL ELECTRONICS TEST EQUIPMENTS

Learning Unit 6
Time: 15 Hrs

OBJECTIVE

COMPREHEND DIFFERENT NUMBER SYSTEMS, CODES AND BINARY ARITHMETIC

SUB OBJECTIVES

1 Convert in one code to the equivalent number in another code

2 Correctly subtract binary numbers by using the complement method

3 Show with a circuit how an ALU such as the 74181 can be used to perform any of 16 logic functions or 16 arithmetic functions on two 4 bit input variables

4 Perform binary multiplication and division by add and shift algorithm

ASSESSMENT CRITERIA

1 The student should be able to convert a number on one code to the equivalent number in another code

Example

Convert (4E) to binary

2 The student should be able to do simple binary arithmetic

Example

Subtract 10110 from 11001 using 2's complements

3 74181 testing

TOPICS

Binary, octal, hexa decimal, BCD code, Gray code, seven segment display code, parity bit, ASCII

Digital Arithmetic:

Addition, subtraction, arithmetic logic unit, multiplication, division, fixed point and floating point Nos.

Learning Unit 6

PRACTICAL ACTIVITY

Construction and testing of half adder

Construction and testing of full adder

Testing of 4 bit adder using 7483

Testing of arithmetic and logic unit IC 74181

REFERENCES

1 MICROPROCESSORS AND DIGITAL SYSTEMS

Chapter 3,7
Hall
McGraw-Hill

2 DIGITAL COMPUTER FUNDAMENTALS

Chapter 3, 7
Bartee
McGraw-Hill

2.2 DIGITAL ELECTRONICS AND TEST EQUIPMENT Learning Unit 7
Time: 20 hrs

OBJECTIVE

SELECT AND USE LOGIC PROBE, OSCILISCOPE, DMM, PULSE GENERATOR AND FREQUENCY COUNTERS IN TESTING DIGITAL CIRCUITS

SUB OBJECTIVE

1 Use logic probe, oscilloscope or DMM in testing digital IC circuit

2 Use a pule generator as a signal source

3 Know the limitations like bandwidth, frequency range of the test equipments

ASSESSMENT CRITERIA

The student should be able to select and use the test equipment in checking the digital IC circuit

Example

Use dual trace oscilloscope in testing the digital clock circuit

TOPIC

Operation, specification and applications of Digital multimeter, logic probe and pulse generator

Oscilloscope - input coupling, trigger controls, probes, delayed time base, mltiple trace and application

Logic analyser fundamentals

Selection of suitable test equipment for the environment particulary between logic probe and Oscilloscope.

Practice of use with digital multimeter, logic probe and pulse generator

Practice of use with oscilloscope

Practice of use with logic analyser

REFERENCE

MICROPROCESSORS AND DIGITAL SYSTEMS

Chapter 1
Hall

2.3 ELECTRONICS DRAFTING — Total: 80 Hrs

OBJECTIVES

1 Prepare drawings related to sheet metal work - Chassis, Cabinet, Panels and Racks and also hardware assembly of parts in various peripherals.

2 Interpret and use correctly the standard symbols for electronic devices, components hardware etc.

3 Prepare the following diagrams using standard symbols:

- i block diagrams
- ii schematic diagrams
- iii layout diagrams
- iv inter connection/wiring diagrams
- v logic diagrams

4 Design and prepare PCB layout and inter connection diagrams (artwork) for simple linear and digital circuits for single and double sided boards adopting standard board sizes, using manual procedures and computer graphics facilities.

2.3 ELECTRONICS DRAFTING Total: 80 Hrs

Practical

Sl.No.	Drawings to be prepared
1	Chassis diagram of monitor
2	Chassis diagram of CPU unit
3	Design & drawing chassis diagram for mounting a set of PCBS & related hardware
4	Panel diagram of the micro computer
5	Design & drawing panel diagram for a test equipment for mounting various controls and picture tube (Designing a panel diagram for CRO)
6	Isometric views of the cabinets monitor and CPU
7	Assembly drawing of a keyboard
8	Assembly drawing and sketches of paper movement mechanism of the printer
9	Assembly drawing and sketches of ribbon movement mechanism in the printer
10	Assembly drawing of a floppy drive mechanism
11	Mounting diagram of the picture tube of the monitor and heat sinks of power transistor and diodes
	TEST
12	Standard symbols for active and passive components as per national standards
13	Standard symbols for electronic hardware
14	Schematic & block diagram of monitor
15	Schematic & block diagram of floppy & hard disk drive
16	Schematic & block diagram of printer circuits
	TEST
17	Layout diagram of memory board and mother board
18	Layout diagram of PCB of preipherals
19	Interconnection and wiring diagrams of stepper motor and servomotor
20	Interconnection and wiring diagram of picture tube

21 Logic diagrams of SSI & LSI chips commonly used in the computer hardware industry

22 Design and prepare layout drawings & printed circuit for a single sided PCB

23 Prepare enlarged layout and printed circuit diagrams for photo reduction

24 Design and prepare layout drawing and printed circuit for a double sided PCB, using computer graphics and software design packages

25 Circuit diagram of the given assembled PCB

TEST

REFERENCES

1 ELECTRONICS TECHNIQUES - Shop Practices & Construction

Chapter 2
Robert S Villanucci
Prentice Hall Inc. Eagle Wood Cliffs

2 DESIGN AND CONSTRUCTION OF ELECTRONIC EQUIPMENT

Chapters 7, 8
George Shiers
Prentice Hall Inc. Eagle Wood Cliffs
New Jersey

3 OPERATING AND SERVICE MANUALS OF PERHIPHERALS

4 PICTORIAL DRAWING DEVELOPMENT AND MODEL MAKING

J E Mattick
W Foulsam & Co Ltd
S Slough, Perks UK

5 ELECTRICAL AND ELECTRONICS DRAWING

Charles J Paer
McGraw Hill

6 IEEE & EIA AND NATIONAL CODE AND SPECIFICATIONS

7 ELECTRONIC DRAFTING

K Karl Kuller
McGraw Hill Book Co

8 ELECTRICAL AND ELECTRONICS DRAFTING

Herbert W Richer
John Wiley & Sons

9 PRINTED CIRCUIT BOARDS, DESIGN & TECHNOLOGY

Walter C Bossheaut
Tata McGraw Hill Publishing Co Lts
New Delhi

10 PRINTED CIRCUIT HAND BOOK

Clyde F Coombs JR
McGraw Hill Book Co

11 SOFTWARE MANUALS OF DESIGN PACKAGES

Note: Whenever possible students should be encouraged to use computer aided design systems for the preparation of drawings and printed circuit board layouts.

2.2 ELECTRONICS DRAFTING

Learning Unit 1
Time: 15 Hrs

OBJECTIVE

PREPARE DRAWINGS RELATED TO SHEET METAL WORK CHASSIS, CABINETS, PANELS AND RACKS AND ALSO HARDWARE ASSEMBLY OF PARTS IN VARIOUS PERIPLERALS

SUB OBJECTIVES

1 Given the components, sockets, connectors and units to be mounted on a chassis, prepare a chassis drawing and development diagrams specifying the sizes of holes for fixing the accessories and drawing dimension lines.

2 Given the list of accessories to be mounted on a panel such as CRT, floppy drives, lamps, switches, prepare the panel drawing with the proper spacing between the various mountings for operational convenience.

3 Given the type and size of chassis and panels to be fixed, design a suitable cabinet/rack and prepare the related mechanical drawing in orthographic and isometric projection.

4 Given the mechanical assembly drawing of panels, chassis, interpret the scheme of layout of the components, sockets, connectors, units and other accessories.

5 Study the actual hardware assembly mechanism used in different computer peripherals and prepare drawings and sketches which will facilitate reassembly.

6 Prepare heat sink assembly and mounting diagrams.

ASSESSMENT CRITERIA

1 Given the requirements of mounting, the student must be able to prepare the necessary drawings for sheet metal work giving the developed view of metal requirements.

2 Given the drawing of assembly of mechanical parts and the actual unit, the student must be able to understand the assembly.

3 For given assembled parts and mechanisms, the student must be able to prepare the necessary drawings and sketches to scale and add dimension lines.

Example

Study the actual assembly of ribbon movement mechanism, in a printer, prepare a suitable sketch or drawing to facilitate replacement of parts.

Learning Unit 1

TOPICS

Fundamentals of Electric Drafting.
Selection of drawing sheets, pencils and letter sizes for titles and references, techniques of Orthographic, isometric and oblique, first and third angle projections, development diagrams, dimension lines.

PRACTICAL ACTIVITIES

Preparation of first angle and third angle projection of cabinets, chairs, panels and racks. Preparation of isometric view of a VDU and keyboard. Draw the developed view of metal requirements for the fabrication. Preparation of assembly drawings and sketches of mechanisms and mechanical parts used in the peripherals of micro computers and also of heat sink mounting diagram.

REFERENCES

1 ELECTRONIC TECHNIQUES - Shop Practices & Construction

Chapter 2
Robert S Villanucci
Prentice Hall Inc Eagle Wood Cliffs

2 DESIGN AND CONSTRUCTION OF ELECTRONIC EQUIPMENT

Chapters 7, 8
George Shiers
Prentice Hall Inc Eagle Wood Cliffs
New Jersey

3 OPERATING & SERVICE MANUALS OF PERIPHERALS

4 PICTORIAL DRAWING DEVELOPMENT AND MODEL MAKING

J E Mattick
W Foulsam and Co Ltd
S Slough Berks UK

5 ELECTRICAL AND ELECTRONICS DRAWING

Charles J Baer
McGraw Hill

2.3 ELECTRONIC DRAFTING

Learning Unit 2
Time: 5 Hrs

OBJECTIVE

INTERPRET AND USE CORRECTLY THE STANDARD SYMBOLS FOR ELECTRONIC DEVICES, COMPONENTS, HARDWARE ETC. USED IN A MICRO COMPUTER.

SUB OBJECTIVES

1 Select and use suitable templates for electronic drawing

2 Prepare drawings of symbols and conventions of various electronic devices, components & hardware as per IEEE, EIA or national codes and standards.

3 Draw extender symbols for transfer of line to next page.

4 Interpret the symbols of codes and conventions used for representing the elctronic devices & hardware.

ASSESSMENT CRITERIA

1 The student must be able to sketch the symbols and conventions for any given device

2 Interpret symbols, codes and conventions given in schematic and wiring diagrams used in microcomputers.

TOPICS;

Electronic symbols and codes.
National conventions and practices. Symbols for active and passsive components and hardware, use of templates.

ASSESSMENT CRITERIA

Preparation of drawing plates giving the symbols of various devices and components adopting National Codes and Practices.

REFERENCES

IEEE & EIA AND NATIONAL CODE AND SPECIFICATIONS.

Electrical and Electronics Drafting

Herbert W Richer
John Wiley & Sons

Learning Unit 2

Electronic Techniques

Robert S Villanucci
Prentice Hall Inc

Electronic Drafting
K Karl Kuller
McGraw Hill Book Ltd

2.3 ELECTRONIC DRAFTING

Learning Unit 3
Time: 30 Hrs

OBJECTIVES

PREPARE THE FOLLOWING DIAGRAMS AS PER STANDARD PRACTICE:

i Block diagrams
ii Schematic Diagrams
iii Component Layout diagrams
iv Inter connection/wiring/highway diagrams
v Logic diagrams

SUB OBJECTIVES

1 Prepare schematic & block diagrams of sub assembly of key board, monitor, floppy drives, hard disc drive, printers allowing the diagram to span over two or three pages with suitable references marks to connections of other pages.

2 Prepare component layout diagrams of memory board, mother board, printed circuit board assemblies (PCBA) of peripherals & micro processor trainer.

3 Prepare interconnection and wiring diagrams such as that of stepper motor in floppy drive, servo motor in printer, picture tube in monitor etc.

4 Prepare and interpret logic diagrams given in data sheets for SSI & LSI chips.

5 Draw component location chart for easy identifications of resistor capacitors, I.C.s etc.

TOPICS:

Techniques of drawing block diagrams and rules for schematic diagrams and their uses - Standard practices of indicating interconnections on different pages, principles and uses of component location charts, standards used in interconnection and wiring diagrams.

PRACTICAL ACTIVITIES

Preparation of different diagrams listed under the Sub Objective listed above.

REFERENCES

Operation and Service Manuals of peripherals

ELECTRICAL AND ELECTRONICS DRAWING

Charles J Baer
McGraw Hill

ELECTRICAL AND ELECTRONICS DRAFTING

Herbert W Richer
John Wiley & Sons

2.3 ELECTRONIC DRAFTING

Learning Unit 4
Time: 30 Hrs

OBJECTIVE

DESIGN AND PREPARE PCB LAYOUT AND INTER CONNECTION DIAGRAMS ART WORK FOR SIMPLE LINEAR AND DIGITAL CIRCUITS FOR SINGLE AND DOUBLE SIDED BOARDS ADOPTING STANDARD BOARD SIZES. USING MANUAL PROCEDURES AND COMPUTER GRAPHICS FACILITIES.

SUB OBJECTIVE

Given the circuit diagram of a regulated D.C. supply, A.F. and R.F. amplifier or oscillator and digital circuits:

1 Prepare the component layout diagram for actual size.

2 Prepare the inter connection diagram without cross covers.

3 Prepare Master (enlarged) layout and printed circuit diagram for photo reduction meeting the professional standards.

4 Estimate the board sizes and list specifications of PCB.

5 Given the circuit diagram of simple digital circuits (10 I.C.s) demanding double sided boards. Prepare the layout diagram and inter connections and solder kark diagrams for both the sides.

6 Given the assembled PCB, the student must be able to trace the circuit and prepare the circuit diagram.

7 Given the circuit diagram, design PCBs using a micro computer with appropriate design packages.

ASSESSMENT CRITERIA

1 Given any linear or digital circuit the student must be able to prepare the PCB layout & interconnection diagram.

2 Given the actual PCB, the student must be able to trace the circuit diagram.

TOPICS:

Design of printed circuit boards.
Selection of suitable scale and board sizes, general approaches to artwork design, rules for artwork design for low frequency and high frequency circuits, calculation of conductor width for high current carrying conductors, guidelines for discrete components and I.Cs, use of stickers and tapes, rules and interconnection of double sided PCBs, solder mark design.

PRACTICAL ACTIVITIES

Design of PCB and preparation of art work for simple and complex circuits using discrete devices and I.Cs. Trace and draw the circuit diagram of a given assembled PCB.

REFERENCES

1 ELECTRONIC TECHNIQUES - Shop Practices & Construction.

Robert S Villanucci
Prentice Hall Inc USA Chapters 9,10,11 & 12

2 PRINTED CIRCUIT BOARDS Design & Technology

Walter C Bossheaut
Tata McGraw Hill Publishing Co Ltd
New Delhi

3 PRINTED CIRCUIT HANDBOOK

Clyde F Coombs JR
McGraw Hill Book Co

4 SOFTWARE MANUALS OF APPROPRIATE PACKAGES FOR DRAFTING & ARTWORK

2.4 Project Work in Electronics Total 120 Hrs

Given the problem, design the circuit using ICs, assemble and test the circuits. Projects similar to the following may be given as Students' project:

1 Transistor Tester

2 Continuity Tester

3 Pulse Generator

4 Frequency Counter

5 Function Generator

6 Digital Voltmeter

7 Logic Probe

8 Switched mode power supply

9 Audio Amplifier

10 8 Trace oscillator display

11 Speed control of motor

12 0-30V DC variable regulated power supply

13 Digital Clock

14 Twilight Relay

15 Solid state contactor

16 Relay type Stabilizer

3.1 MICRO COMPUTER HARDWARE Total: 160 Hrs

OBJECTIVES

1 Identify the various system hardware elements:

- Processor module
- Memory module
- Standard Buses
- Interrupt control module
- Interface module

2 Identify steps involved in the exchange of data between processor and external hardwares

3 Be familiar with working principles and applications of I/O devices

4 Be familiar with terms, standards and equipment associated with data communications.

3.1 MICRO COMPUTER HARDWARE Total: 60 Hrs

Theory (Electrical Characteristics)

Structure of the micro computer system: 7

System Unit:

Power Supply distribution
The mother board & expansion slots.
Chips: Intel 8088 processor, 8087 numeric data processor, 8259 interrupt controller, 8284 clock generator, ROM, 8253 programmable interval timer, 8257 direct memory access controller, 8255 programmable segmentation and bank switching peripheral interface, RAM and chip Inofmration chart chip location guide and micro computer data sheet. Handling precautions of SMPS.

Micro Computer Interfacing: 3

Input/output buses and functions, generalised peripheral control unit PCU or adapter, direct I/O versus buffered I/O, analog and digital interfacing.

Monitors: 10

Principles of monochrome and colour monitors, horizontal and vertical sweep circuits, EHT, monochrome picture tube, colour signal processing, refresh memory character generation, screen geometry, screen timing, cursor control, display timings, concept of resolution, band width and pixels, low, medium and high resolution graphics specifications, monochrome and colour video circuitry, vertical synchronistion circuitry, high resolution, low resolution and graphics circuitry, monochrome adapter. colour/graphics adapter and their chip location guides.

Keyboards: 8

Encoders, output codes, static encoder, lockout and roll over, scanning encoder, special purpose keys, parallel keyboard interface, keyboard circuitry & keyboard PCB. Auto repeat feature keyboard buffer.

Floppy Drives & Hard Disks: 8

Principles of operation, physical constraints Access/Read/Write controls, read circuitry, write circuitry, drive select circuitry, disk drive analog card, drive adapter card and their chip location guide.

Cassette Drives: 3

Principles of operation, magnetic recording methods, cassett drives, cassette data input and output circuitry chip locations in mother board.

Printers: 4

Principles of operationm parallel or serial interface, printer circuitry and printer PCB. Printer buffer.

Plotters & Digitisers: 3

Principles of operation, serial interface, plotter circuitry and plotter PCB.

Speakers, lightpen, mouse & joystick: 4

Principles of operation, speaker output circuitry, lightpen circuitry game control adapter and pair of joysticks connection, mouse circuitry.

Data transmission and modems:

Principles of communications, Bit, Byte Frame transfers, synchrnous, asynchronous transfers, methods of data transfer, transmission lines, networks, modulation, modems, UART and USART chip, interfaces, multiplexing, error detection & correction, ISO standards. Networks. Topology - ring, star, bus, tree carrier sense multiple access, token ring Register insertion ring.

TEST

REFERENCE

1 MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry
Van Nostrand Reinhold
NEW YORK

2 MICRO COMPUTER DESIGN AND CONSTRUCTION

Alan Clements
Prentice-Hall International

3 MICRO ELECTRONIC SYSTEMS -Micro Computer Hardware Level I

P Cooke Technician Education Council, London

4 MICRO ELECTRONICS SYSTEMS - Level II

Pred Hallsall
Technician Education Council, London

5 MICRO ELECTRONIC SYSTEMS - Level III

Dr D J Woollons
Technician Education Council, London

6 IBM PC TROUBLE SHOOTING & REPAIR GUIDE

Robert C Brenner
Howard W Sams & Co Inc USA

7 INTEL DATA PRODUCT SYSTEMS MANUALS

8 IBM PC TECHNICAL REFERENCE MANUAL

9 INSIDE THE IBM PC

3.1 MICRO COMPUTER HARDWARE Total: 100 Hrs

Practicals

With the help of IBM PC data sheet, chip information chart and the service manuals

1) Identify and locate components in the system

2) Measure voltages at relevant points: and

3) Check for appropriate signals at various stages

of the following

System: 15

Power Supply Distribution
Power supply connectors and pin assignments, board orientation
Over voltage/over current protection arrangements, Processor chip, clock circuitry chips & crystal, ROM (start up data)
Interrupt controller chip, DMA chip, Programmable peripheral interface chip, Bus controller chip. Ram chips, System board DIP switch settings, Co processor chip.

Monitor: 20

Monochrome/colour adapter card, CRT controller chip, character generator chip MK 36000, low and high resolution graphics chips, vertical synchronisation signals, horizontal synchronisation signals, vertical size, linearity, roll, centering, focussing. Safe handling of EHT.

Keyboard: 15

Keyboard cable & 5 pin DIN sonnector signals reaching mother board, signals to/from data bus, keyboard.

Floppy & Hard disk: 15

Disk drive adapter card, disk drive analog card, (check also oscilloscope patterns at the test points in the above PCBs as recommended in the service manuals), Head alignment.

Cassette: 5

Signal coming from tape, signal sent to tape, Input-output circuitry.

PRACTICAL TEST

Printers & Plotters: 10

DIP switch settings, parallel or serial interface and signals,printer adapter PCB. Print buffer.

Speakers, light-pen, mouse and joystick: 10

Signals at pins of connector of monochrome adapter card, signals at pins of three connectors of colour/graphics adapter card, connecting light pen, mouse or joysticks, signals from light pen circuitry to data bus, lightpen circuitry chips in colour/graphics, signals at game control adapter for joysticks PCB.

Data Communication and Modems: 10

Signals at UART or USART chips, connecting modems and lines. Checking of performance to two PCs connected with modems back to back.

PRACTICAL TEST

3.1 MICRO COMPUTER HARDWARE

Learning Unit 1
Time: 22 Hrs

OBJECTIVE

IDENTIFY THE VARIOUS SYSTEM HARDWARE ELEMENTS

- Processor module
- memory module
- standard buses
- interrupt control module
- interface module

SUB OBJECTIVES

1 For the given processor chip, using data sheets obtain its characteristics like material, data bits, memory bus, packaging pins, no. of onterrupt lines, no. of general registers and shift registers.

2 Identify the RAM & ROM chips used in the system and obtain the characteristics from manufacturers' data sheets.

3 Identify the type of standard buses used with the system and pin assignments.

4 Comprehend the interrupt control schemes for a typical micro computer system.

5 Comprehend the interfacing through external bus (the Electronic Industries Association) EIA-RS-232 C and RS 443 for serial hook up.

ASSESSMENT CRITERIA

Given a micro computer system, the student must be able to

1 trace and identify the above hardware elements

2 state their working principle

3 specify their ratings

4 refer to the data manual and identify the characteristics of the modules.

TOPICS

Structure of the micro computer system:

System Unit:

Power supply distribution
The mother board & expansion slots.
ICs: processor. numeric data processor, interrupt controller, clock generator, ROM, programmable interval timer, direct memory access controller, programmable, segmentation and bankswitching, peripheral interface, RAM and chip information chart, chip location guide and micro computer data sheet. Handling precautions of SMPS

PRACTICAL ACTIVITY:

With the help of IBM PC data sheet, chip information chart and the service manuals

1) Identify and locate components in the system

2) Measure voltages at relevant points: and

3) Check for appropriate signals at various stages

of the following:

System:

Power supplu connectors and pin assignments, board orientation over voltage/over current protection arrangement, Processor chip, clock circuitry chips & crystal, ROM (start up data) Interrupt controller chip, Programmable interval timer chip, DMA chip, Programmable peripheral interface chip, Bus controller chip, RAM chips, system board DIP switch settings.

REFERENCE

1 MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry pages 1-25
Van Nostrand Reinhold
NEW YORK

2 MICRO COMPUTER DESIGN AND CONSTRUCTION

Alan Clements pages 30-226
Prentice-Hall International

3 MICRO ELECTRONIC SYSTEMS -
Micro Computer Hardware Level I pages 95-115

P COOKE
Technician Education Council, London

4 MICRO ELECTRONIC SYSTEMS - Level II

Fred Hallsall pages 141-163
Technician Education Council, London

5 MICRO ELECTRONIC SYSTEMS - Level III

Dr D J Woollons pages 39-105
Technician Education Council, London

6 IBM PC TROUBLE SHOOTING & REPAIR GUIDE

Robert C Brenner pages 13-56
Howard W Sams & Co Inc USA

3.1 MICRO COMPUTER HARDWARE

Learning Unit 2
Time: 7 Hrs

OBJECTIVE

IDENTIFY STEPS INVOLVED IN THE EXCHANGE OF DATA BETWEEN PROCESSOR AND EXTERNAL HARDWARE.

SUB OBJECTIVES

1 Sketch and explain the generalised block diagram of a peripheral control unit for providing necessary interfacing between and external hardware and processor.

2 Explain how a command form the processor for a particular external device is decoded by a typical PCU, developing the necessary control voltage levels, strobes etc.

3 State the need and nature of control signals and timing signals for proper data transfer.

4 State how error indications from external hardware are handled by the processor.

5 Check the lines and signals of PCUs actually used in various peripherals such as Printer, floppy drive and tape systems.

ASSESSMENT CRITERIA

Given a peripheral control unit for any computer peripheral, the student must be able to check input signals, controls, output signals & alarms.

Example

Given a peripheral control unit for floppy drive and the manual, identify the following:

- Response line
- Acknowledge line
- Interrupt line
- Data in/Data out lines
- Read/Write line
- Serial data line
- Head select line

TOPICS

Micro computer interfacing:

Input/output, buses and functions, generalised peripheral control unit PCU or adapter, direct I/O versus buffered I/O, analog and digital interfacing.

PRACTICAL ACTIVITY

Micro computer Interfacing:

Examine in detail the controls, signal their functions and interface schemes of typical PCUs of a printer, magnetic tape and disk systems.

REFERENCES

1 A USER'S GUIDE TO COMPUTER PERIPHERAL

Donald Eadie
Prentice-Hall Pages 109-145

2 MICRO ELECTRONICS SYSTEM - Level III

Dr D J Woollons Pages 165-210
Technician Education Council, London

3.1 MICRO COMPUTER HARDWARE

Learning Unit 3
Time:115 Hrs

OBJECTIVE

BE FAMILIAR WITH WORKING PRINCIPLES AND APPLICATIONS OF I/O DEVICES.

SUB OBJECTIVES

Comprehend the working of the following, interpret the specification and check their functions:

1 Key board:

Key switch mechanisms and types of encoders to convert key impressions into digital signals and also the lockout, roll over, drivers and keyboard buffers and special purpose keys, auto repeat feature.

2 CRT Displsy Units:

Individual character generation, display representation, cursor control display timings and the special types of CRT display devices for graphics.

3 Printers:

Teletype, Selectric, Daisy-wheel, Thimble, Band and Belt, Impact, Dot matrix and Ink Jet printers.

4 Cassettes and Cartridge devices:

Magnetic recording and digital recording, audio cassette/computer interface.

5 Floppy and hard disc:

The physical structure and sub assemblies and controllers for floppy and hard disk.

6 Graphic Input and output:

X-Y coordinate digitiser and other analog devices like light pen, mouse and paddle (joy stick) and plotter.

ASSESSMENT CRITERIA

Given any external peripheral device, the student must be able to explain its working principle and interpret the manufacturer's specifications and check their functions.

TOPICS:

Monitors
Keyboards
Floppy drives & Hard disks
Cassette drives
Printers
Plotters & Digitisers
Speakers, lightpen, mouse 7 joystick

Sub topics as detailed under the head theory for the above subject.

PRACTICAL ACTIVITY:

With the help of IBM PC data sheet, chip information chart and the service manuals

1) Identify and locate components in the system

2) Measure voltages at relevant points and

3) Check for appropriate signals at various stages

of the following (Details of stages are provided under practical for the above subject)

Monitor
Keyboard
Floppy & Hard disk
Cassette
Printers & Plotters
Speakers, light-pen, mouse and joysticks

REFERENCE

1 MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry
Van Nostrand Reinhold
New York Pages 57-192

2 A USER'S GUIDE TO COMPUTER PERIPHERALS

Donald Eadie
Prentice Hall Inc.
New Jersey Pages 40-108

3 MICRO ELECTRONIC SYSTEMS LEVEL I

P Cooke
Technician Education Council
London Pages 79-92

4 MANUFACTURERS DEVICE DESCRIPTION MANUALS

3.1 MICRO COMPUTER HARDWARE

Learning Unit 4
Time: 16 Hrs

OBJECTIVE

BE FAMILIAR WITH TERMS, STANDARDS AND EQUIPMENTS ASSOCIATED WITH DATA COMMUNICATIONS

SUB OBJECTIVES

1 Be familiar with the definitions of transmission media, channel, trunk, full duplex, half duplex, dedicated lines and characteristics of telephone lines.

2 Understand parallel and serial data transfers and how data in binary serial form is transmitted over the normal telephone communication network facilities.

3 Be familiar with basic functions of low speed MODEM and connections on cummunication line side and on data terminal side.

4 Be familiar with character orientated and bit orientated protocols and start-stop asynchronous and synchronous protocols & USART in particular.

5 Identify the UART modem chips and current loop interface in a typical remote data communication system and understand their functions.

6 Be familiar with ISO model layers for communication.

ASSESSMENT CRITERIA

Given a micro computer system serving in a communication network, the student must be able to trace and identify the data port, UART control port, Modem port and Timing control port.

TOPICS

Data transmission and Modems:

Principles of communications, bit, byte frame, transfers, synchronous, asynchronous transfers, methods of data transfer, transmission lines, networks, modulation, modems, UART and USART chip, interfaces, multiplexing, error detection & correction, ISO standards.

PRACTICAL ACTIVITY

Data Communication and Modems:

Signals at UART or USART chips, connecting modems and lines. Checking of performance of two PCs connected with modems.

REFERENCES

1 MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry
Van Nostrand Reinhold Co
New York Oages 208-232

2 A USER'S GUIDE TO COMPUTER PERIPHERAL DIGITAL COMMUNICATIONS

Donald Eadie
Prentice Hall Inc Pages 146-176

3 ISO STANDARD MANUAL FOR DIGITAL COMMUNICTIONS.

3.2 MICROPROCESSORS Total 160 Hrs

OBJECTIVES

1 Understand the function of basic Microprocessor system

2 Prepare and check assembly language programs on a suitable Microprocessor Kit

3 Be familiar with interfacing techniques

4 Test and service simple faults using hardware and software techniques.

3.2 MICROPROCESSOR Total 60 Hrs

Theory : Content

Microprocessor Structure and Programming: 15

General organisation in a digital computer and microprocessor kit, Bus structure, internal architecture of microprocessor, ALU, registers, instruction register, control circuits, programming models.

Assembly language program

Instruction set of micro processor, data transfer group, arithemetic and logic group, branch and control group, writing assembly langauge programs, flow chart, examples of assembly language programming, use of subroutines, hand assembling a program, debugging assembly language program, verifying the step by step CPU operation during instruction execution. Assembler Directives.

System Hardare Timing: 12

Block diagram and pin description, instruction cycles, machine cycles and states, schematic of micro processor kit. Address decoding, port decoding, segmentation, memory-mapped I/O and direct I/O.

Micro computer timing parameters

Wait, hold and halt states, hold state and direct memory access, interrupts, masking and enabling. Block diagram and pin description of a limited range of currently available microprocessors.

Input and Output Interfacing: 22

Simple input or output, polled I/O. interrupt I/O, hand shake input or output, single strobe I/O, double hand shake I/O, generating hand shake signals, programmable I/O port ICs. programmable timers.

Interfacing keyboard, hardware and software approach, interfacing seven segment displays, interfacing D/A and A/D converters, parallel bus standards, IEEE 448 bus standards, serial data input and output, modems and RS 232C interface, programmable serial port ICs.

Interfacing CRT display monitor, EPROM programmer, in circuit emulators.

Servicing Simple Faults: 4

Debugging assembly language programs using single stepping and break points, tracing the signals in address and data bus lines and control lines, simple diagnostic program to test I/O port and memory.

TEST 4

REFERENCE

1 EXPERIMENTS IN MICROPROCESSOR AND DIGITAL SYSTEMS

Hall
McGraw Hill

2 MICROPROCESSOR AND DIGITAL SYSTEMS
Chapters 8,9,11

Hall
McGraw Hill

3 MICROPROCESSOR KIT MANUAL

3.2 MICROPROCESSOR Total: 100 Hrs

Practical

Sl.No.	Suggested Activities
1	Microprocessor kit familiarisation
2	Entering and testing sample programs - I
3	Entering and testing sample programs - II
4	Inputting through key board and getting the result in the display
5	Debugging the program using single stepping and break points
6	Writing and testing time delay programs
7	Writing and testing programs using subroutines
8	Writing and testing programs using interrupts
	PRACTICAL TEST
9	Study of timing signal, instruction cycle time, m/c cycle time and state time
10	Study of address decoding and memory decoding
11	Study of 1 bit input and output in SID and SOD pins
12	Construction and testing programmable peripheral chip I/O port in Mode O.
13	Construction and testing I/O, memory and timer IC
14	Writing and testing diagnostic program for testing I/O ports and memory
15	Testing signal flow in address bus, data bus and control lines
16	Interfacing External Hex Key Board
17	Interfacing multiplexed seven segment LED display
18	Construction and testing of A/D converter using D/A converter IC
19	Interfacing A/D converter IC
20	Stepper motor interface

PRACTICAL TEST

21 Construction and testing of Timer in different modes

22 Study of cassette interface

23 Study of serial communication between kit and dumb terminal

24 Interfacing LSI clock circuit for a real time interface

25 Study of hand shaking I/O using chip in mode 1

26 Study of interrupt controller chip

27 Working with In circuit emulator - I

28 Working with In circuit emulator - II

29 Working with In circuit emulator - III

PRACTICAL TEST

30 Processor diagnostics

31 Prepare programs to test faults in microprocessor

3.2 MICROPROCESSOR

Learning Unit 1
Time: 10 Hrs

OBJECTIVE

UNDERSTAND THE FUNCTION OF BASIC MICROPROCESSOR SYSTEM

SUB OBJECTIVES

1 Draw the block diagram of microprocessor kit showing the bus routings

2 Understand the internal architecture of microprocessor

3 Trace signal paths on buses for an instruction fetch and execute

4 Comprehend the signal paths between memory key board, display and CPU.

ASSESSMENT CRITERIA

The student should be able to understand the operation of a microprocessor system.

Example

Explain the functional blocks in the microprocessor system.

TOPICS

Microprocessor Structure and Programming:

General organisation in a digital computer and microprocessor kit, bus structure, internal architecture, ALU, registers, instruction register, control circuits.

PRACTICAL ACTIVITY

Microprocessor Kit familiarisation
Entering and testing sample programs - I
Entering and testing sample programs - II

REFERENCE

1 MICROPROCESSOR AND DIGITAL SYSTEMS

Chapter 8
Hall
McGraw- Hill

2 MICROPROCESSOR KIT MANUAL

3.2 MICROPROCESSORS

Learning Unit 2
Time: 55 Hrs

OBJECTIVE

PREPARE AND CHECK ASSEMBLY LANGUAGE PROGRAMS USING APPROPRIATE MICROPROCESSOR KIT

SUB OBJECTIVES

1 Describe the operation performed by instructions

2 Use of sub-routines

3 Explain how interrupts are serviced in the system

4 Define instruction cycle, machine cycle and machine state

5 Prepare and enter simple assembly language programs in microprocessor kit

6 Debug the program using break points and single step operation

7 Comprehend assembler directives.

ASSESSMENT CRITERIA

For a given problem, student should be able to write an assembly language program, enter and test the program in the microprocessor kit.

Example

Write a program to use the kit as digital clock. Test the program in the kit.

TOPICS

Assembly Language Programs:

Instruction set of micro processor, data transfer group, arithmetic and logic group, branch and control group, writing assembly language programs, flow chart, examples of assembly language programming, use of subroutines, hand assembling a program, debugging assembly language program, verifying the step by step CPU operation during intruction execution.

System Hardware and Timing:

Block daigram and pin description, instruction cycles and states, system schematic, address decoding, port decoding, memory mapped I/O and direct I/O.

Micro Computer timing Parameters:

Wait, hold and halt states, hold state and direct memory access, interrupts, masking and enabling, block diagram and pin description.

PRACTICAL ACTIVITY

Inputting through keyboard and getting the result in the display

Writing and testing time delay programs

Writing and testing programs using subroutines

Writing and testing programs using interrupts

Study of timing signals, instruction cycle time and state time

Study of address decoding and memory decoding

Study of single input and output in SID and SOD pins

REFERENCE

MICROPROCESSORS AND DIGITAL SYSTEMS

- Chpaters 8,9
  Hall
  McGraw-Hill

3.2 MICROPROCESSOR

Learning Unit 3
Time: 75 Hrs

OBJECTIVE

BE FAMILIAR WITH INTERFACING TECHNIQUES

SUB OBJECTIVES

1 Interface simple input/output port like LED/switch, key board and seven segment display

2 Interpret the details of programmable peripheral ICs given in data books

3 Use simple programmable peripheral ICs for input/output ports, timers and serial communication ICs

4 Know the parallel and serial bus standards

5 Use EPROM programmers and In-circuit emulators.

ASSESSMENT CRITERIA

For a given problem, the student should be able to

i choose appropriate interface IC or devices
ii draw the proper circuit
iii connect and test the circuit with software

Example

Connect a decimal key board and 4 digit displays as input/output ports and test it.

TOPICS

Input and Output Interfaing:

Simple input or output, polled I/O, interrupt I/O, handshake input and output, single strobe I/O, single handshake I/O, double handshake I/O, ġenerating handshake signals, programmable I/O port ICs, programmable timers.

Interfacing keyboard, hardware and software approach, interfacing seven segment displays, interfacing D/A and A/D converters, parallel bus standards, IEEE 488 bus standards, serial data input and output, modems and RS 232C (interface), programmable serial port ICs.

Interfacing CRT displays monitor, EPROM programmer, in-circuit emulators

PRACTICAL ACTIVITY

Construction and testing of programmable peripheral chip I/O port in Mode O

Construction and testing I/O memory timer IC

Interface an external Hex Key Board

Interface A/D converter IC

Construct stepper motor interface

Construction and testing of a timer in different modes

Study of cassette interface

Study of serial communication between kit and dumb terminal

Interfacing LSI clock circuit for a real time interface

Study of hand shaking I/O

Study of interrupt controller chip

Working with In-circuit emulator - I

Working with In-circuit emulator - II

Working with In-circuit emulator - III

REFERENCE

MICROPROCESSORS AND DIGITAL SYSTEMS

Chapter 11
Hall
McGraw-Hill

3.2 MICROPROCESSOR

Learning Unit 4
Time: 15 Hrs

OBJECTIVE

TEST AND SERVICE FAULTS USING HARDWARE AND SOFTWARE TECHNIQUES

SUB OBJECTIVES

1 Describe steps for testing and debugging ROM, RAM and I/O ports

2 Identify fault in the microprocessor system by tracing signal and clock signal path

3 Write simple diagnostic programs for testing I/O ports and memory

ASSESSMENT CRITERIA

The student should be able to correct simple fault in the microprocessor system by tracing the signal

Example

In the microprocessor kit, assume that the display section is not working, trace the faults and correct it.

TOPICS

Servicing the faults:

Debugging asssembly language program using single stepping and break points, tracing the signals in address and date bus and control lines, simple diagnostic program to test I/O ports and memory.

PRACTICAL ACTIVITY

Debugging the program using single stepping and break points

Writing and testing diagnostic program for testing I/O ports and memory

Processor diagnostics

Tracing the signal flow in address bus, data bus and control lines.

REFERENCE

MICROPROCESSOR AND DIGITAL SYSTEMS

Hall
McGraw-Hill

3.3 COMPUTER ORGANISATION AND HIGH LEVEL PROGRAMMING

Total: 160 Hrs

OBJECTIVES

1 Understand the working of digital computer

2 Be familiar with the basic ideas of high level languages, assemblers, compilers and operating systems

3 Acquire skill in using system commands and utilities of currently available operating systems

4 Prepare, debug and execute various types of programs for scientific, graphic and commercial applications.

3.3 COMPUTER OGANISATION AND HIGH LEVEL PROGRAMMING

Total: 160 Hrs

Theory	HRS
Input devices:	3

VDU, dumb & intellegent terminals, monochrome, colour, special purpose terminals such as point of sale or retail terminals, optical mark sense, magnetic ink character recognition (MICR). Portable terminals with modems, light pen, mouse.

Output devices: 2

Printers, line printers, impact and nonimpact printers, dasiy wheel and dot matrix printers, ink-jet printers, laser printers, graph plotters, drum plotters and falt bed plotters.

Data Entry devices: 2

Key to tape, key to cassett/cartridge, key to disc devices.

Secondary Storage devices: 3

Magnetic tape, method of recording, 7 track and 9 track, advantages of tape, magnetic cassette tape and cartridges, magnetic disc, winchester disc and floppy disc drives, disc organisation and formatting, handling of floppy diskc.

Techniques of Programming: 8

Need for programming, machine code and machine language, assembly language, function of assembler, high level languages, function of compiler and interpreters, error daignostics, program development cycle, algorithms and flow charts, documentation contexts, concepts of data processing, files and records, searching, sorting & merging, random and sequencial access to records, data bases, elements of systems analysis and design.

Micro computer Applications: 2

Office automation, computers in stores and supermarkets, commercial and business data processing, traffic control, computers in medicine, computers in education, process control, communication, information retrieval, work station. CAD, CAM Image processing.

High Level Programming: 2

Character set, constants and variables, assignment 18 statements, control statements, loops, library functions, strings, subscripted variables, sequential and random files, various types and levels of programs with scientific and commercial applications, graphics, basic colour commands and statements.

3.3 COMPUTER ORGANISATION AND HIGH LEVEL PROGRAMMING — Time: 100 Hrs

PRACTICAL

Sl.No.	Activity
1	Operation of peripherals, interconnection and setting up the Micro computer system
2	Entering & executing programs in a high lvel language using Assignment statements Control Statement Loops Library functions Strings Subscripted variables Graphics & colour Sequential files Random files TEST
3	Practice the use of system commands and utilities for various operating systems
4	Use of Editor EDLIN and Wordprocessor WORDSTAR
5	Creating file for given source programs in FORTRAN, COBOL
6	Compiling, linking and executing FORTRAN and COBOL programs
7	Application programs for scientific and commercial problems
8	Use of authoring languages TEST
9	Practice the usage of DBASE III, LOTUS 1-2-3.

3.3 COMPUTER ORGANISATION AND HIGH LEVEL PROGRAMMING

Learning Unit 1
Time: 25 Hrs

OBJECTIVE

UNDERSTAND THE WORKING OF DIGITAL COMPUTERS

SUB OBJECTIVES

1 List the hardware and software units that constitute a computer system

2 For each of the unit –
   i) identify its function and working principle
   ii) interpret its specification
   iii) make proper interconnection with the CPU

3 Understand the various controls and settings and their functions in each of the input, output and secondary storage devices and operate them safely with care

4 Specify the need for monitor programmes and system diskettes

5 Understand the codes and coding system used for flow of signals between I/O devices

6 Comprehend the various areas in which micro computers are used.

ASSESSMENT CRITERIA

1 Represent a computer system in the form of a block diagram and explain its working

2 List the various types of peripherals that could be connected to the system along with their specification

3 Given the relevant manufacturers' manuals of the peripherals–
Make proper inter connection and check the operation of the computer and its peripheral devices.

TOPICS

Input devices, output devices, Secondary storage devices, data entry devices, Micro computer applications.
Topic details for these areas are as listed under the head 'Theory" for the above subject.

PRACTICAL ACTIVITIES

Operation of various peripherals independently and with inter connections–
Setting up the micro computer system.

REFERENCES

INTRODUCTION TO COMPUTERS Chapter 1
Pages 3-30

Gorden B Davis
International Student Edition
McGraw Hill International Book Company
London.

3.3 COMPUTER ORGANISATION AND HIGH LEVEL PROGRAMMING

Learning Unit 2
Time: 45 Hrs

OBJECTIVE

BE FAMILIAR WITH THE BASIC IDEAS IF HIGH LEVEL LANGUAGES, ASSEMBLERS, COMPILERS AND OPERATING SYSTEMS

SUB OBJECTIVES

1 Explain the need for high level languages

2 Given a simple source program in any language, enter the programme in the computer using Editor

3 Compile and link program

4 Execute and run program

5 Execute simple assembly level programs

6 Comprehend the basic ways in which assemblers and compilers function

7 Establish how the operating system serves its function

8 Comprehend elementary ideas of system analysis and design

9 Understand the fundamentals of authoring languages.

ASSESSMENT CRITERIA

1 Execute with a specific example how a high level program is translated into machine language and executed

2 Interpret the compiler and linkage editor listing and messages

3 State the functions of the operating system and illustrate how it executes those functions.

TOPICS

Techniques of programming:

Need for programming, machine code and machine language, assenbly language, function of assembler, high level languages, function of compiler and interpretters, error diagnostics, program development cycle, algorithms and flow charts, documentation, levels of documentation, documentation contexts, concepts of data processing, random and sequential access to records, data bases, elements of systems analysis and design.

Learning Unit 1

FORTRAN & COBOL:

Elementary ideas of FORTRAN and COBOL, nature of the source program, process of compilation, linking and executing simple FORTRAN and COBOL programs. Basic ideas of authoring languages.

PRACTICAL ACTIVITIES

COMPUTER STUDIES - A first course

John Shelley & Roger Hant
Pitman Publishing Ltd UK.

3.3 COMPUTER ORGANISATION AND HIGH LEVEL PROGRAMMING

Learning Unit 3
Time: 30 Hrs

OBJECTIVE

ACQUIRE SKILL IS USING SYSTEM COMMANDS AND UTILITIES OF A CURRENTLY AVAILABLE OPERATING SYSTEMS

SUB OBJECTIVES

1 List the various system commands associated with different operating systems

2 Execute the system commands, such as formatting diskettes, saving and loading files, listing the file contents, copying files, renaming files, erasing of files, getting the directory, memory dumping etc. for different operating systems by referring to the manuals, if necessary.

3 Be familiar with the use of various utilities available with the operating systems.

ASSESSMENT CRITERIA

Given any micro computer and the operating system manual, the student must be able to carry out all the system commands and utilities and check their execution.

TOPICS

Operating Systems and Commands:

Different types of operating systems such as batch processing, single user, multi programming, timesharing and distributed data processing.

Study of system commands for formatting diskette, saving and loading files, listing the file contents, copying files, renaming files, erasing of files, getting the directory, memory dumping etc. for CP/M, MS DOS. XENIX operating systems.

System Utilities:

Use and handling of various utilities such as SORT, MERGE, TEXT EDITOR, WORDSTAR, DBASE III. LOTUS 1-2-3. IBM PC debug programs.

PRACTICAL ACTIVITIES

Practice of system commands for various operating systems.

Use of different utilities.

REFERENCE

OPERATING SYSTEM MANUALS OF CP/M

Ashton-Tate

MS DOS (Micro soft), XENIDX (AT & T).

3.3 COMPUTER ORGANISATION AND HIGH LEVEL PROGRAMMING

Learning Unit 4
Time: 60 Hrs

OBJECTIVE

PREPARE, DEBUG AND EXECUTE VARIOUS TYPES OF PROGRAMS FOR SCIENTIFIC, GRAPHIC AND COMMERCIAL APPLICATIONS

SUB OBJECTIVES

For the chosen language -

1 Classify the group of characters as alphabets, numerals, arithmetic operators and punctuation characters

2 Define the constants and variables

3 Comprehend the syntax framing various types of statements

4 Comprehend the concept of creation and processing sequential and random files

5 Prepare and execute statements that produce colour and/or graphics

6 Interpret and execute various system commands

7 Prepare flow charts and programs for simple scientific and commercial applications

8 Execute various prepared programs, debugging them, if necessary

ASSESSMENT CRIERIA

Given a problem, the student must flow chart and prepare a program and run the program eliminating bugs if any.

TOPICS

High level language, character set, constants and variables, assignment statements, control statements, loops, library functions, strings, subscripted varaibles, sequential and random files, various types and levels of programs with scientific and commercial applications, graphics.

PRACTICAL ACTIVITIES

Preparation and execution of programs involving different statements including files, strings and graphics.

REFERENCES

* Suitable manuals relating to the specific implementation of the language.

3.4 Project Work in Microprocessors Total: 120 Hrs

Given the circuit diagram and software, the Project should involve assembly, testing and commissioning of microprocessor based circuits related to computer or any other system.

Projects similar to the following may be given as Students' Projects:

1 Traffic Controller

2 Stop watch/time and event controller

3 Temperature Controller

4 Security on doors and alarm

5 Lift controller

6 IC Tester

7 EPROM programmer

8 Transient recorder

9 Annunciator

10 Running Display

11 DC-DC converter

12 Code

4.1 COMPUTER INSTALLATION AND MAINTENANCE — Total: 120 Hrs

OBJECTIVES

1 Interpret site plans, electrical wiring drawings

2 Configure and carry out commissioning tests on micro computer systems at site

3 Carry out maintenance of systems

4 Maintain log books and stock registers for an installation.

4.1 COMPUTER INSTALLATION AND MAINTENANCE — Total: 60 Hrs

Theory — Hrs

Computer Site Preparation: 5

Site plan, equipment physical planning, electrical power, lighting, earthing, air conditioning, fire protection, smoke detection, voltage stabilisation, uninterrupted power supply, avoiding noise interference, corrosion and stray magnetic fields. Protection against ingress of virmin.

Configuration and Commissioning Systems: 10

Visual inspection and removing locks at site. Distribution software, limitations, planning new configurations, system generation, documentation, software testing, bench-mark testing. Offline testing & self tests for peripherals and testing of Hardware diagnostics before actual system tests. Configuring with co-processor.

Maintenance: 20

Preparing preventive maintenance schedules, screen and cabinet cleaning, antistatic sprays, checking filters, shields, circuit cross talk, cleaning circuit pins and connectors, special points for disk maintenance, using special solvents like ISO propyl alcohol or methanol, disk speed tests, alignment and adjustments. Care of static electricity problems.

Installation Logs and Registers: 10

Significance of Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR), equipment history record, record of configurationchanges, operational log sheet, system components replacement log, inventory log, repair listings, cautions and notes.

Visits: 10

Visit neighbouring installations and computer servicing departments to discuss the field practices of maintenance.

TEST 5

REFERENCES

1 Site preparation recommendations and product information sheets from different micro computer manufacturers

2 Standard O.S. generation procedures for MS-DOS, CP/M etc. from supplier.

3 IBM PC TROUBLE SHOOTING & REPAIR GUIDE
Robert V Brenner
Howard W Sams & Co Inc USA

4 OPERATING AND SERVICING MANUALS OF SUPPLIERS

5 SAMPLE LOG SHEETS AND PROCEDURES ADOPTED IN ACTUAL INSTALLATIONS

4.1 COMPUTER INSTALLATION AND MAINTENANCE — Total: 60 Hrs

Practical Calibration Installation: — Hrs

System — 20

Checking of Mother & Adopter Boards.

Floppy Drives Clock Speed

Calibrating disk speed using tuning lamp & tachometer, aligning with special alignment disk, if required.

Hard Disk Drives

Checking magnetic integrity, cleaning disk unit surfaces.

Checking bad tracks and too many retries.

Monitors

Cleaning cabinet and screen, setting the controls.

Keyboards and Printers

Setting controls & alignment, cleaning dust off keyboards and ventilation openings, lubricating mechanical parts and recommended lubricants only where it is required and specified.

Tapes

Cleaning rollers, hub, other guides and recording heads.

Configuring, generating, precommissioning new systems and bench-mark testing — 10

Carry out optimum preventive maintenance for a typical installation as per Instructor's plans. — 30

Miscellaneous:

Cleaning computer system work area, equipment housings & cases, display screens, cleaning inside computer, printer, ventilation filters inside equipments, vacuum cleaning printer heads, motors and moving carriage trains.

4.1 COMPUTER INSTALLATION AND MAINTENANCE

Learning Unit 1
Time: 15 Hrs

OBJECTIVE

INTERPRET SITE PLANS, ELECTRICAL WIRING DRAWINGS

SUB OBJECTIVES

1 Be familiar with overall requirements of computer site preparation

   i) site plan, airconditioning
   ii) electrical power, lighting and earthing layout
   iii) fire protection layout
   iv) smoke detection layout
   v) check protection against ingress virman

2 Understand the effect of temperature, vibration, dust, humidity on the Micro computer hardware performance and resulting failures

3 Estimate the power requirements, and fuse ratings for individual units

4 Be familiar with stabilised voltage sources and uninterrupted power sources and their operations for meeting special sistuations

5 Be familiar with handling of vacuum cleaners for removing dust from peripherals etc.

ASSESSMENT CRITERIA

The student must be able to identify and plan favourable external conditions for the micro computer installations

Example

Identify correct location and select the correct mains, fuses and power connectors for installing multi user micro computer system with 3 terminals and 2 printers with the help of manufacture's specification data sheets and manuals.

TOPICS

Computer Site Preparation:

Site plan, equipment physical planning, electrical power, lighting, earthing, air-conditioning, fire protection, smoke detection, voltage stabilisation, uniterrupted power supply, avoiding noise interference, corrosion and stray magnetic fields.

PRACTICAL ACTIVITY

Visiting neighbouring installations to study the electrical, air-conditioning, fire protection and other physical planning details.

REFERENCE

Site preparation recommendations and product informations sheets from different micro computer manufacturers.

4.1 COMPUTER INSTALLATION AND MAINTENANCE

Learning Unit 2
Time: 20 Hrs

OBJECTIVE

CONFIGURE AND CARRY OUT COMMISSIONING TESTS ON MICRO COMPUTER SYSTEMS AT SITE

SUB OBJECTIVES

1 Be familiar with operating system distribution software for a micro computer system

2 Configure and perform system generation for a given installation with and without co-processor

3 Document the options and system generation details in log books for future reference

4 Test all the system utility programs supporting the operating system

5 Execute test programs and bench-mark programs supplied in the distribution system as pre-commissioning check

ASSESSMENT CRITERIA

Given a micro computer system amd operating system distribution software, the student must be able to configure and perform system generation and carry out precommissioning checks for any user's options.

Example

Configure a system for the following specifications:

Memory	-	256K	
Floppy	-	DSDD-5 1/4	- 2 Nos
Printer	-	80 Column	- Serial output

TOPICS

Configuring and Commissioning Systems:
Pre commissioning inspection and removing locks at site.
Distribution software, limitations, planning new configurations, system generation, documentation, software testing, configuring with co-processor.

PRACTICAL ACTIVITY

Generating and precommissioning new systems for various configurations.

REFERENCE

Standard O.S generation procedures for MS-DOS, CP/M etc. from suppliers

4.1 COMPUTER INSTALLATION AND MAINTENANCE

Learning Unit 3
Time: 20 Hrs

OBJECTIVE

CARRY OUT MAINTENANCE OF SYSTEMS

SUB OBJECTIVES

1 Understand the need for maintenance for maximum machine readiness with minimum down time

2 Prepare suitable maintenance schedule covering frequency, time required etc for any Micro Computer System and carry out the schedule

3 Estimate and prepare the list of spares to be stocked for the maintenance

ASSESSMENT CRITERIA

Given an installation with sizeable number of micro computer systems and peripherals, the student must be able to plan and carry out the maintenance schedule on the lines given below as an example for a floppy drive;

Sl.NO.	Schedule	Frequency (Maths)	Time Reqd.for maint.	Service Manual ref(pgNo)	Access. Reqd.
1	Stepper Motor Head screw lubrications	12	10	100	Lub. oil
2	Head-load pad	12	20	96	-

TOPICS

Maintenance:

Preparing maintenance schedules, screen and cabinet cleaning, antistatic sprays, checking filters, shields, circuit cross talk, special points for disk maintenance, using special solvents like Isopropyl alcohol or methanol, disk speed tests, alignment and adjustments.

Care of static electricity problems.

PRACTICAL ACTIVITY

1 Maintenance (General):

System
Floppy Drives
Hard Disk Drives
Monitors
Keyboards and Printers
Cassette Tapes

2 Configuring, generating, precommissioning new systems and bench-mark testing

3 Carry out optium maintenance for a typical installation

4 Miscellaneous:

Cleaning computer system work area, equipment housings & cases, display screens, cleaning inside computer, printer, ventilation filters inside equipments, vacuum clean printer heads, motors and moving carriage trains.

REFERENCES

1 IBM PC Trouble Shooting & Repair Guide

Robert C Brenner
Howard W Sams & Co Inc USA Pages 135 - 160

2 Operating and Servicing Manuals of Suppliers.

4.1 COMPUTER INSTALLATION AND MAINTENANCE

Learning Unit 4
Time: 15 Hrs

OBJECTIVE

MAINTAIN LOG & STOCK REGISTERS FOR AN INSTALLATION

SUB OBJECTIVES

1 Prepare a log register for an installation covering micro computer and its peripherals detailing

- i start and stop time recording for every unit
- ii unit failures – nature and description of failures
- iii record of operating system messages at the time of failures
- iv failure reporting time and repaired time

2 Prepare a log register for all the units such as stabilisers, airconditioning etc. for a computer installation

3 Prepare and maintain a stock register for the spare parts and consumables like stationery, ribbon etc. for an installation.

ASSESSMENT CRITERIA

The student must be able to design and maintain a suitable register sheet for a given installation.

TOPICS

Installation logs and registers:

Significance of MTBF and MTTR, equipment history record, record of configuration changes, operational sheet, maintenance schedules, system components replacmeent log, repair listings, stock registers, inventory registers, cautions and notes.

PRACTICAL ACTIVITY

Visit to neighbouring installations and computer servicing departments to discuss the field practices of log and stock maintenance.

REFERENCES

1 IBM PC Trouble SDhooting & Repair Guide

Robert C Brenner
Howard W SAms & Co Inc USA Pages 181-190

2 Sample log sheets and procedures adopted in actual installations.

4.2 COMPUTER PERIPHERALS

Total: 180 Hrs

OBJECTIVES

1 Comprehend the range of computer peripherals used with micro computer

2 Understand schemes for interfacing different peripheral devices with processor

3 Interpret the manufacturer's assembly drawings and wiring diagrams and identify the individual components and parts and their functions of various peripherals

4 Adjust the settings required for various peripherals.

4.2 COMPUTER PERIPHERALS

Total: 60 Hrs

Theory (Mechnaical characteristics) Hrs

1 Monitors (Monochrome/colour): 5

Characteristics, ratings, sizes, voltage, power, stability, radiation level, tolerance, temperature, frequency ranges, colour/graphics display adapter. adapter cables, parts assembly details, interfacing, common faults and adjustments.

2 Keyboards: 10

Characteristics, sizes & types, key switch mechanisms, mechnaical keys, cross-point keys, reed keys, capacitive keys, hall-effect keys, parts assembly details, key bounce, interfacing, common faults and adjustments.

3 Floppy and Hard disks: 10

Characteristics, ratings, sizes & stability, floppy drive mechanisms: Track-O switch, head loading, write protection, LED/Photo transistor, index sensing, head advancement, stepper motor functions, drive control and motor-belt transmission, interfacing, common faults and adjustments.

4 Tapes Drives: 6

Types, stability, sizes require digital cassettes, incremental cassettes, head loading, write protection, LED/Photo transistor, index sensing, stepper motor controls, drive control and motor-belt transmissions, interfacing, common faults and adjustments.

5 Printers: 15

Characteristics, ratings, sizes, laser jet. thermal printers, daisy-wheel and thimble printers, medium speed printers; Band and belt type, impact dot matrix and ink jet type. Print mechanisms, print head mechanism, platen drives, rack and pawl escapement mechanism daisywheel carriage movement, carriage drive for dot matrix printer, pin feed platen, forms tractor, multiple pass printing, continuous ink jet and on-demand ink jet mechanisms, interfacing, common faults and adjustments.

6 Plotters & Digitisers: 5

Characteristics, ratings, sizes, tolerance, carriage movement and carriage drive stepper motors, pen movement. lifting/lowering mechanisms and detailed construction details, interfacing, common faults and adjustments.

		Hrs
7	Speakers, Lightpen, Joystick & Mouse:	5
	Characteristics, ratings, sizes, tolerances, and construction details, interfacing, common faults and adjustments.	
	TEST	4

REFERENCES

1 A USER'S GUIDE TO COMPUTER PERIPHERALS

Donald Eadie
Prentice Hall, Inc. New Jersey

2 MANUFACTURER'S OPERATING AND SERVICE MANUALS

3 MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry
Van Nostrand Reinhold Co New York

4 MANUFACTURERS PARTS CATALOGUES AND ASSEMBLY DRAWINGS

4.2 COMPUTER PERIPHERALS — Total: 120 Hrs

Practicals — Hrs

Refer to concerned manufacturer's operating and service manuals and study the details of the following peripherals and carry out the related activities mentioned below:

1 Monitors (Monochrome/Colour): 15

Checking name plate details & specifications of picture tube, power connections, control switches, connectors and ratings of fuses, chassis earthing and shields for EHT circuits.

Disassembly and reassembly of monitor, adapter cards, video cables, power and other tuning swtiches.

Tube pulling and substitution.

Adjusting magnets, focussing and scan rates.

2 Keyboards (different types/makes): 15

Checking power connections and ratings of fuses, keyboard contact mechanism, disassembly of keys, platinum contacts and latches, lubricating keybars, latch levers, hooks and locking mechanisms.

PRACTICAL TEST

3 Checking name plate details and specifications, power connections, fuse ratings and earthings, accelebration of drive motor timings of stepper motor, read/write head gap and its importance.

Disassembly and reassembly of the following mechanisms:

Track O switch	Head load pad & Head carraige
Head load solenoid	Cone clamp
Write protection switch	Beam clamp & Platen load
Door interlocks	Drive motor & Belt
Diskette ejection	Stepper motor
	Cooling arrangement

Cleaning of magnetic recording head, lubricating stepper motor and other mechanical moving parts.

PRACTICAL TEST

4 Tapes Drives (Streamer, Cassette & other types): 10

Checking name plate detils and specifications, power connections, fuse ratings and earthings, acceleration of drive motor, read/write head gap, disassembly and reassembly of the floowing mechanisms:

Head load solenoid
Write protection switch
Door interlocks
Tape ejection
Head load
Drive motor and belt

Cleaning of magnetic recording head, lubricating drive motor and door closing system as specified by manufacturer.

5 Printers: (Teletype, Selectric, Daisy Wheel, Thimble, Dotmatrix and ink jet) 25

Checking name plate details and specifications, power connections, fuse ratings and earthings, DIP switch settings for parity, protocol and data bit length, quality of printing by built-in slef test program.

Disassembly and reassembly of the following mechanisms:

Carriage assembly
Printer hammer group
Ribbon feed mechanism and ribbon replacement
Paper feed and tractor attachment
Motor belt and tension adjustment

Lubricating moving parts in above assemblies.

6 Plotters & Digitisers: 15

Checking

name plate details and specifications,
power connections, fuse ratings and earthings,
DIP switch settings for parity & protocol mode

Disassembly and reassembly of the following mechanisms

Pen cariage and lifting/lowering
Steppers motors
X-Y axis guides
Cursor attachment

Lubricating guides, stepper assembly and other moving mechanical parts.

7 Speaker, lightpen, joysticj, mouse & modems: 15

Checking

name plate details and specifications,
power connections, fuse ratings and earthings,
DIP switch settings for parity & protocol modes

Disassembly and reassembly of the following:

Light pen assembly
Joysticj potentiometers
Mouse assembly
Modem assembly and
replacement & testing of speaker.

PRACTICAL TEST

4.2 COMPUTER PERIPHERALS

Learning Unit 1
Time: 40 Hrs

OBJECTIVE

FOR A GIVEN APPLICATION ASSESS THE MOST APPROPRIATE SET OF PERIPHERALS

SUB OBJECTIVES

1 Identify the commonly used micro computer peripherals such as

Keyboards and CRT display units
Floppy and hard disk drives
Cassettes and tape drives
Printers and plotters; and
Light-pen, Joystick, Mouse & Digitisers

2 List the mechanical and electrical specifications of usch peripherals covering models, dimensions, weight, power requirements, operating temperature, speed of operation and ratings.

3 List the various capacities and ranges of each peripheral covering density per inch, tracks per inch, lines per inch for relevant peripherals.

4 Interpret the specifications of each peripheral as found in the Manufacturer's Operating and Service manuals.

5 understand the guidelines for selecting a suitable peripheral for a given application.

ASSESSMENT CRITERIA

1 Given the requirements of a peripheral, the student must be able to

i select it and state the justification for selection
ii list its ratings and specification

Example

Select the particular type of printers for a micro computer system to print its output at 300 lines/mt. in a commercial installation with heavy printing load. List its full ratings and specification.

2 Given any peripheral, the student must be able to refer its operating and serice manuals and interpret its specifications.

Example

Find the power consumption rotation speed and weight of the 8" floppy disk unit of Calcomp make.

TOPICS

Study of the specifications and characteristics of different types of Monitors, keyboards, floppy disk drives, hard disk drives, tape drives, printers, plotters, digitisers, speakers, light pens, joysticks, mouses and modems.

PRACTICAL ACTIVITY

Given the requirement of a peripheral, selection has to be done by consulting different data sheets for proper ratings and specifications.

REFERENCE

A USER'S GUIDE TO COMPUTER PERIPHERALS

Donald Eadie
Prentice Hall, Inc. New Jersey.

4.2 COMPUTER PERIPHERALS

Learning Unit 2
Time: 40 Hrs

OBJECTIVE

UNDERSTAND SCHEMES FOR INTERFACING DIFFERENT PERIPHERAL DEVICES WITH PROCESSOR

SUB OBJECTIVES

1 Define the scheme of interface serial or parallel and state whether it is common standard to all micro computer systems

2 Comprehend the standard bit rates (baud) and handshaking for RS 232C links

3 From the manufacturer's specifications, identify the elctrical ranges and impedence restrictions on the interfacing equipment, maximum number of loads permitted, ground shifts allowed between equipments, etc.

4 Identify the physical restrictions such as length, number and type of cables, connectors and lines.

5 interpret the specifications relating to any special interfaces such as direct analog lines, range of permissible voltages impedence levels and accuracies.

ASSESSMENT CRITERIA

Given any micro computer system with its peripheral devices, the student must be able to

i identify the interface shceme adopted for each peripheral, and
ii state the restrictions

Example

For a given serial printer, locate the interface cable and connector and check the recommendations and restrictions as found in the manufacturer's data sheets.

TOPICS

Schemes of interfacing, standard links, physical and electrical restrictions, special insterfaces.

PRACTICAL ACTIVITIES

Identifying interface schemes adopted for the peripherals of the given Micro computer system.

REFERENCE

Manufacturers' Operating and Service Manuals.

4.2 COMPUTER PERIPHERALS

Learning Unit 3
Time: 40 Hrs

OBJECTIVE

INTERPRET THE MANUFACTURER'S ASSEMBLY DRAWINGS AND WIRING DIAGRAMS AND IDENTIFY THE INDIVIDUAL COMPONENTS AND PARTS AND THEIR FUNCTIONS OF THE VARIOUS PERIPHERALS

SUB OBJECTIVES

From manufacturer's assembly drawings, identify and study

1 the return spring mechanism and contact arrangements for the conventional keybaords

2 the power, intensity and shift controls of a CRT display unit and interpret the specifications of vertical scan rate, horizontal scan rate, dot rate of a typical CRT display unit

3 printing mechanism associated with a range of printers

4 For a floppy and hard disk drive

the cooling arrangement, drive separation arrangements, power connections and head load arrangements, LED/photo transistor arrangement for a drive motor and index sensing devices

5 the assembly and interconnection of the special accessories for graphics such as light-pen, mouse, joystick and digitisers.

ASSESSMENT CRITERIA

Given any peripheral device, the student must be able to identify the various components and parts and explain their working.

Example

Given the floppy drive and its operating manual, study the door open/close switch, and explain its working.

TOPIC

Study of parts assembly of the keyboards, printers, floppy systems and other special peripherals.

Learning Unit 3

PRACTICAL ACTIVITIES

Using manufactuer's parts assembly drawings, disassemble and reassemble the contact arrangements in keyboards, printing mechanisms in printers, drive mechanisms in floppy system.

REFERENCE

1 MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry
Van Nostrand Reinhold Co. New York

2 Manufacturers Parts Catalogues and Asembly Drawings.

4.2 COMPUTER PERIPHERAL

Learning Unit 4
time: 60 Hrs

OBJECTIVE

ADJUST THE SETTINGS REQUIRED FOR VARIOUS PERIPHERALS

SUB OBJECTIVES

From manufacturer's components assembly drawings, make the following adjustments for the various peripherals:

1 the settings of return springs, clean and adjust the contacts for any conventional keyboards

2 the settings for vertical scan rate, horizontal character rate, dot rate etc. for a typical CRT display device

3 the settings of switch selectable transmission speed, (baud rate), parity generation, full/half duplex modes of printer connections

4 the ribbon tension, ribbon lift solenoid, ribbon stepping motor, printer wheel servo motor, hammer magnet settings etc. for a typical printer

5 R/W head load solenoid mechanism, door interlocks, spindle motor head positioning, stepper motor arrangement

6 the hard disk controller components head position arrangement, spindle motor arrangement and air filter facilities

7 the mechanical components of the audio cassette, digital cassette and incremental cassette devices

8 the components of graphic input devices such as light-pens, mouse, joystick and X-Y coordinate digitisers.

ASSESSMENT CRTIERIA

For any peripheral device

1 identify the various mechanical and electronic c components

2 trace and sketch the wiring diagram for verification with actual circuits provided in the manual

3 check the normal settings and voltages in actual circuit as recommended by the manufactuers

4 check and make the necessary mechanical adjustments and replace the parts if necessary.

Example 1

When it is necessary to replace the head carriage assembly of the floppy drive, stepper motor is to be removed. Trace the elctrical connections to the stepper motor and measure the actual voltages across its leads for subsequent replacement and checking.

Example 2

For a medium speed printer, identify the components of pawl/ratchet platen drive used for paper advancement and adjust it for proper functioning.

TOPIC

Manufacturer's recommendations for various mechanical and electrical settings of the components of the peripherals.

PRACTICAL ACTIVITIES

Identify mechanical and electrical components.

Tracing and checking wiring diagrams.

Checking normal recommended settings and voltages in actual circuits.

Making necessary mechanical adjustments.

REFERENCE

MICRO COMPUTER SYSTEMS

Ivan Flores & Christopher Terry
Van Nostrand Reinhold Co. New York.

4.3 SYSTEM DIAGNOSTICS AND FAULT ANALYSIS

Total: 180 Hrs

OBJECTIVES

1 Given the call report from customer, identify at the site whether the fault is software or hardware related.

2 Adopt systematic steps for hardware fault finding, isolation and rectification, maintaining personal diary of fault elimination.

3 Select and use suitable test equipments to isolate the defective components on a faulty PCB.

4.3 SYSTEM DIAGNOSTICS AND FAULT ANALYSIS — Total: 60 Hrs

Theory	Hrs
Preliminary Analysis:	16

Identification of faults software or hardware or operational procedural error

Hardware Faults:

Identifying external causes like dust, dirt, static electricity, heat, humidity shock, vibration, electrical noises and radio frequency interferences and ageing.

Examining conditions existing at the time of faults:

Hard or intermittent.

Visual inspection, open circuits, short circuits, bent or broken pins, solder splashes & corrossion at chips, resistors, capacitors, diodes, transistors, crystals & relays.

Documenting the error codes and messages at the time of faults.

Detailed Analysis: 40

Preparation of test plans:

Checking warranties and consulting manuals to match symptons with trouble-shooting recommendations and servicing guidelines.

At the field and at the repair cell:

Identifying fault subassembly or peripherals:

- by analysing the symptoms
- by executing diagnostics available or
- by substitution of written programs
- by examining system performance logs

Identifying faults within the sub-assembly or peripherals:

- by visual inspection
- by executing self-tests and examining error codes
- by executing licensed or self written diganostics programs
- by probing with logic probes or oscilloscopes
- by replacing fault unit by good spare
- by using ATE (Automatic Test Equipment) or similar equipment
- by using special equipments like logic chip pulsers, current probes, IC testers & repair cell.

At manufacturing end:

- thermal imaging & use of heat sensitive liquid crystals
- testing of individual components
- burn in all or critical components
- physical inspection of PCBs and assemblies
- inspect solder splashes and other manufacturing defects
- power up and start testing function by function by diagnostics or suitable tests
- test the complete assembly with full software and utilities
- subject to quality control checks and tests
- adopt suitable packings for despatch.

TEST 4

4.3 SYSTEM DIAGNOSTICS AND FAULT ANALYSIS — Total: 120 Hrs

	Practical	Hrs
1	Fault analysis:	10

Given a faulty computer system, use simple programs in assembler language for testing memory location, eg

- simple store and read test
- sequential numbers test
- rotating bit test
- walking bit test
- dual address test
- butterfield test

2	Use built in self test program available for peripherals and offline testing wherever necesaary	5
3	Use licensed diagnostic software available for IBM-PC for fault analysis and other exercisers and preparing their own diagnostic programs	10
4	Use traditional test equipments like oscilloscopes, digital multi meters, volt-ohm-milliammeters and electro static discharge kits	5
5	Use special test equipments like logic pulsers, logic probes, current tracers, IC testers.	10
6	Use special tolls like IC extractors, infrared guns, collant sprayers for repairs and use log registers for recording serial numbers of all system components removed or replaced	5

The instructor should simulate the following fault conditions for diagnostic exercises by inserting faulty chips, tape pasting on connectors, cutting tracks, bridging the tracks, shorting IC pins with wires.

The students should prepare a repair listing of what is to be repaired or replaced:

7	Start up problems (system) :	15

- No beep nothing happens
- continuous beep
- repeating short beep
- 1 long 1 short beep
- 1 long 2 short beeps
- memory failure
- wrong DIP switch settings

Hrs

- RAM chip malfunction
- expansion unit or cable malfunction
- no clock - bad crystal
- no start up data - bad ROM
- CPU failure - bad chip

8 Monitor: 15

- no display
- bad cable
- brightness out of adjustment
- no video signals at adapter card
- video signal too small
- bad character generator
- no vertical synchronisation signal to monitor
- no resolution mode select
- no text but graphics works
- bad characters displayed
- monitors mis adjusted
- colour signal improper

9 Practical Test 2

10 Key board: 10

Key board not responding, signal not reaching mother board, no character being generated, no signal getting to data bus, printing wrong character, one or more keys won't work, key board stays in upper case only or lower case only. Removal and replacement of keys.

11 Printers/Plotters: 5

Units not responding, signal not reaching concerned PCBs, signal not getting to data-bus, printing or plotting wrong characters poor print quality due to broken or bent pins.

12 Floppy drive/Hard disk drive: 10

One drive won't read, wrong drive getting selected, neither drive will read, one drive won't (read functions properly), drives can't be accessed, computer locks up, bad ICs in adapter card, drive electronics signals improper on analog card, drive mechanics bad, bad alignment of heads.

13 Cassette: 5

Signal not coming from cable, signal not getting to data bus, signal not going out of the cable, signal not being sent to tape, bad programmable interval timer chip.

		Hrs
14	Speaker, lightpen, mouse, joystick:	5
	No signal for circuitry to speaker, no signal from circuitry to light pen, joysticks, mouse, light pen won't respond.	
15	Data Communication equipments:	5
	Units not responding, signal not reaching equipment, distance limitations for current loop interface, RS 232-C and RS 449 interfaces.	
	Practical Test	5

REFERENCES

1 MICRO PROCESSOR PRINCIPLES LEVEL IV

Glyn Martin & Nick Heap
Programs for Hardware testing
Technician Education Council London

2 MICRO PROCESSOR BASED SYSTEMS LEVEL IV

A Potton
Technician Education Council

3 DIAGNOSTIC PROGRAMS & TESTING PROCEDURES

User Guides

4 IBM PC TROUBLESHOOTING & REPAIR GUIDE

Robert C Brenner
Howard W Sams & Co Inc USA

5 HOW TO TROUBLE-SHOOT AND REPAIR MICRO COMPUTERS

J D Leuk
Reston Publishing CO USA 1980

6 DIGITAL TROUBLE-SHOOTING MANUALS

Hewlett Packard

7 TROUBLE SHOOTING IN DATA DOMAIN IS SIMPLIFIED BY LOGIC ANALYSERS

W A Farnbach

8 SIGNATURE ANALYSIS - FIELD SERVICE METHOD

R A Frohwerk - Heulet-Packard Journal May 1977

9 MANUFACTURER'S SEVICE MANUALS

4.3 SYSTEM DIAGNOSITCS AND FAULT ANALYSIS

Learning Unit 1
Time: 45 Hrs

OBJECTIVE

GIVEN THE CALL REPORT FROM CUSTOMER, IDENTIFY AT THE SITE, WHETHER THE FAULT IS SOFTWARE OR HARDWARE USING DIAGNOSTIC PROGRAMS

SUB OBJECTIVES

1 Design and implement simple diagnostic or self-test programs in high level or assembly language for testing hardware ports

2 Select and use effectively licensed diagnostic software for the concerned system, interpretting trouble-shooting procedures and messages given in the service manual

3 Given a faulty micro computer system, isolate the fault as software or hardware, by systematic analysis of call report details and running diagnostic programs.

ASSESSMENT CRITERIA

1 Given and faulty micro computer system, the student must be able to

i analyse the call report critically

ii confirm whether the fault is software or hardware for further investigations

iii in the absence of licensed diagnostic programs, design and run simple diagnostic programs to determine the nature of the fault

iv select proper licensed diagnostic programs for test-run

TOPICS

Preliminary Analysis:

Identification of faults
Software or hardware

Software Approach:

Use simple test programs for store and read, sequential number test, rotating bit test, walking bit test, dual address test, butterfield test and sum test.

Use licensed diagnostic programs and built in self-test programs for system and peripherals

Learning Unit 1

PRACTICAL ACTIVITIES

1 Fault Analysis:

Given a faulty computer system, use simple programs in assembler language for testing memory location, eg

- simple store and read test
- sequential numbers test
- rotating bit test
- walking bit test
- dual address test
- butterfield test

2 Use built in self-test program available for peripherals

3 Use licensed diagnostic software available for IBM-PC for fault analysis.

REFERENCES

1 MICRO PROCESSOR PRINCIPLES LEVEL IV

Glyn Martin & Nick Heap
Programs for Hardware testing Pages 146-151
Technician Education Council London

2 MICRO PROCESSOR BASED SYSTEMS LEVEL IV

A Potton Pages 252-271
Technician Education Council London

3 DIAGNOSTIC PROGRAMS & TESTING PROCEDURES

User guides

4 IBM PC TROUBLE-SHOOTING REPAIR GUIDE

Robert C Brenner
Howard W Sams & Co Inc USA Pages 161-179

4.3 SYSTEM DIAGNOSTIC AND FAULT ANALYSIS

Learning Unit 2
Time:100 Hrs

OBJECTIVE

ADOPT SYSTEMATIC STEPS FOR HARDWARE FAULT FINDING, ISOLATION AND RECTIFICATION MAINTAINING PERSONAL DIARY OF FAULT ELIMINATION

SUB OBJECTIVES

1 List typical hardware faults that can occur in a micro computer system as

- component failure
- open circuit interconnections
- short circuit interconnections
- mains-borne interferences

2 Comprehend the need for proper levels of mains voltage, temperature, humidity and other environmental conditions for proper operation of hardware

3 Carry out detailed visual inspection of PCBs and pins of ICs for the following and eliminate the faults, if any:

- proper mounting
- proper earthing
- presence of whiskers
- bridges of solders
- dry joints
- broken component leads
- incorrect diode polarity and transistor lead connections while replacing
- incorrect insertion of ICs in sockets while replacing
- bent pins
- burnt out components

4 Select the equivalent devices for replacing defective components by referring data manuals

ASSESSMENT CRITERIA

After establishing that the fault in the micro computer system due to hardware, the student must be able to

i identify the origin of fault external (temp., dust, humidity etc.) or internal (dry solder etc.)

ii identify whether the fault is at PCB or chip level

iii replace the board or the faulty components

Example

1 Given a faulty PCB, identify by visual inspection, the fault if any and rectify the same

2 For the defective RAM chip of micro computer memory board, select suitable equivalent replacement

TOPICS

Hardware Faults:

Identifying external causes like dust, dirt, static electricity, heat, humidity shock, vibration, electrical noises and radio frequency interferences

Examining conditions existing at the time of faults:

Visual inspection, open circuits, short circuits, bent of broken pins, solder splashes, liguid splashes & corrosion at chips, resistors, capacitors, diodes, transistors, crystals & relays.

Documenting the error codes and messages at the time of faults.

PRACTICAL ACTIVITIES

The Instructor should simulate the following fault conditions for isolating fualts.

The student should prepare a repair listing of what is to be repaired or replaced:

* 1 Start up Problems (System

2 Monitor

* Details of faults to be simulated are provided under the head 'Practical' for the above subject.

3 Keyboard

4 Printers/plotters

5 Floppy drive/hard disk drive

6 Cassette

7 Speaker. lightpen, mouse, joystick

8 Data communication equipment

REFERENCES

1 MICRO PROCESSOR BASED SYSTEMS FAULT FINDING LEVEL IV Pages 252-271

A Potton
Technician Education Council, London

2 HOW TO TROUBLE-SHOOT AND REPAIR MICRO COMPUTERS

J D Leuk
Reston Publishing Co. USA 1980

3 MANUFACTURER'S SERVICE MANUALS

4 IBM PC TROUBLE-SHOOTING & REPAIR GUIDE

Robert C Brenner
Howard W Sams & Co Inc USA Pages 75-134, 161-179

5 DIGITAL TROUBLE-SHOOTING MANUALS

Hewlett-Packard

4.3 SYSTEM DIAGNOSTICS AND FAULT ANALYSIS

Learning Unit 3
Time: 35 Hrs

OBJECTIVE

SELECT AND USE SUITABLE TEST EQUIPMENTS TO ISOLATE THE DEFECTIVE COMPONENTS ON A FAULTY PCB

SUB OBJECTIVES

1 Develop an overall test plan

2 Select suitable test equipments:

i Traditional type of multimeters (analogue or digital) for testing digital circuits

ii CRO for identifying ripples and presence of unwanted pulses or gitches

iii logic probe to identify static levels and use of pulse stretching

iv logic analysers for observing data flow in systems buses (with time and data domain displays)

3 Given a faulty PCB with no apparent visual faults, identify the faulty components by dynamic testing.

ASSESSMENT CRITERIA

1 Explain the use and limitations of each test equipment

2 Given the call report, prepare a test plan

3 Given any faulty PCB of the computer including that of the peripheral, identify the faulty component.

Example

In a micro computer system, it is suspected that a fault exists in the RAM. Explain how a test program could be used to check whether the specified signals are reaching the two RAM chips using oscilloscope.

TOPICS

Detailed Analysis

Preparation of test plan:

Checking warranties and consulting manuals and log registers to match symptons with trouble-shooting recommendations

Learning Unit 3

Hardware approach:

Measuring voltages and signal tracing using test equipments like logic probes, logic chip pulsers, current probes, IC testers, oscilloscopes, volt-ohm-milliammeters, digital multimeters.

PRACTICAL ACTIVITIES

1 Use traditional test equipment like oscilloscopes, digital multi meters, volt-ohm-milliammeters.

2 Use special test equipment like logic pulser, logic probes, current tracers, IC testers, and signature analysers.

3 Use special tools like IC extractors, Infra-red guns, coolant sprayers for repairs and use log registers for recording serial numbers of all system components removed or replaced.

REFERENCES

1 MICRO PROCESSOR BASED SYSTEMS - LEVEL IV

A Potton
Specialised Test Equipment Pages 252-289
Technician Education Council, London

2 TROUBLE-SHOOTING IN DATA DOMAIN IS SIMPLIFIED BY LOGIC ANALYSERS

W A Farnbach - 'Electronics' pages 103-105
May 75

3 SIGNATURE ANALYSIS - Feild Service Method

R A Frohwerk - Heulet-Packard Journal May 1977

4 IBM PC TROUBLE-SHOOTING & REPAIR GUIDE

Robert C Brenner
Howard W Sams & Co Inc USA Pages 75-134
161-179

4.4 PROJECT WORK IN HARDWARE* Total: 120 Hrs

To complete a hardware project involving interfacing of any peripheral to the micro computer as identified and pre-designed by neighbouring computer industries or the instructor.

Project report and documentation to be prepared using a word processor.
Some of the suggested projects are:

1 Design and implementation of buffering scheme for printer

2 Design and implementation of buffering scheme for floppy system

3 Design and implementation of a diagnostic package

4 Design and implementation of character ROM to develop characters in vernacular language

5 PCB design package with graphics

6 Analog to digital conversion and display

7 Coversion of data path from 8 bits to 16 bits

8 Networking of PCs

9 Data Base program menu driven package for specific application

10 Digital storage for slowly varying analog signals

11 Speech synthesiser

*(DATA COMMUNICATION to be offered as Optional subject in place of 60 Hrs of Project Work, if needed).

4.4 DATA COMMUNICATION

Time: 60 Hrs

(To be offered as an alternative for 60 hours of Project Work)

OBJECTIVES

1 Comprehend the working of Data Communication systems

2 Understand the function and characteristics of switched telephone network and telephone lines

3 Connect properly communication lines to data terminal and data communication equipment

4 Comprehend various methods of modulation adopted in data communication

5 Connect a given computer terminal to a host computer using the modem

6 Comprehend the common sources of noise and transmission impairment and methods of overcoming them

4.4 DATA COMMUNICATION

Time: 48 Hrs

Theory	Hrs
Basic Communication Systems	1

Block diagram of a Communication system with all its elements, transmission media and its selection for a given application. Causes of signal impairment.

Data Communication System	2

ISO model of open ended system, interconnections, roles and functions of the layers, devices used a data source and data sinks. Definition of terms such as DCE, DTE, Common Carrier EIA, ISO, CCITT data set etc.

Transmission Channel Measurements	2

Calculation and Measurement of loss through resistive pads for H,T,O and PI pads, decibel units for power voltage and current and their typical application in communication, signal to noise ratio, additive noise voltage in transmission lines.

Transmission line fundamentals	2

Characteristic impedance, attentuation and phase velocity of a transmission line and its typical response to signals, twisted pair and co-axial cables, equalisation as applied to communication.

Characteristics of Telephone lines & Telephone Instruments	2

Power and intellegence distribution of human speech with respect to frequency, lower and upper frequencies of a voice channel as per CCITT, loading of telephone lines and its effect on the performance of the line, operational features of mechanical and touch tone telephones, signal transmission path in a telephone circuit which includes a balancing network, need for side tone.

Switched telephone network	2

Operating principles of step by step, cross bar and electronic switching, merits and demerits of each system of switching, subscriber loop and interface.

Basic Transmission Methods 12

Parallel and serial data transfer, their merits and demerits and applications, definition of a parallel data transfer protocol using strobe and busy hand shake and its limitation, sychronous and asychronous serial data transferm character framing; idle sync, operating principles of UARTS and USARTS, parity, framing errors, operation of active and passive current loop interface, RS 232-C interface and its operation, related connectors and pin number assignments balanced and unbalanced transmission and interfaces, RS 449 interface and its operation and major differences with RS 232-C, base band signalling and its limitation, break out box and its application, use of break out box and its application, use of break out box as a nuil modem.

Modulation 12

Analog modulation, amplitude, frequency and phase modulation, reason for modulating digital base band signals, definition of modulation index and also transmission speed, data rate and their differences, shift key modulation bandwidth requirements and application and implementation, multi-level modulation techniques, definition of dibit and tribit, encoding methods; QAM transmission scheme, delta modulator and demodulator, simple and compounded delta modulation - block diagram, operating principles and applications, pulse code modulation, encoding and its application.

Modems 6

Low speed asynchronous and synchronous modems, their application and operation and method of connection, simplex, half duplex transmission modes, use of originate and answer modems on a switched line. Multiplexing, time division and frequency division multiplexing. Different methods of TDM and their application.

Noise and Distortion 2

Definition of noise and distortion, common sources of noise, transmission impairment and distortion, methods to reduce them.

Error Detection and Correction 3

Need for Error Detection
Definition of parity, LRCC, VRCC, CRC, for error detection, their application. their differences and related error detection schemes, circuit diagram of a CRC generator when given the generator polynomial.

Error correction, define Hamming distance. position of check bits and determination of single bit errors, definition of the overhead and its relationship to the length of the transmitted data word.

REFERENCE

W SINNEMA Digital, analogue and data communication
Reston Publishing Co
Australia

4.4 *DATA COMMUNICATION* Time: 12 Hrs

Practical

The following activities may be carried out as practical exercises:

1. Measurement of transmission loss through different types of resistive pads
2. Measurement of characteristic impedence, attenuation and phase velocity of given cables and transmission lines
3. Testing of serial data link through the interface under software control using a 8 bit microprocessor trainer
4. Preparing cables for interconnection
5. Connecting and testing of DTE's and DCE's using RS 232-C and RS 449 interfaces
6. Study of synchronous and asynchronous modems
7. Installing, testing and eliminating faults in connecting terminal to a host computer through modems.

4.4 DATA COMMUNICATION

Learning Unit 1
Time: 5 Hrs

OBJECTIVE

COMPREHEND THE WORKING OF A DATA COMMUNICATION SYSTEMS

SUB OBJECTIVES

1 Sketch the block diagram of a typical communication system and define all elements in the system

2 List causes of signal impairment in a communication channel

3 Define the functions of the layers of the ISO model

4 Define the terms DCE, DTE, Common Carrier, EIA, ISO, CCITT, data set with reference to Data Communication Systems

ASSESSMENT CRITERIA

The student must be able to describe a data communication system and list at least four causes for signal impairment. He must be familiar with terms and regulations.

TOPICS

Basic Communication Systems

Block diagram of a communication system with all its elements, transmission media and its selection for a given application. Causes of signal impairment.

Data Communication System

ISO model of open ended system, interconnections, roles and functions of the layers, devices used as data source and data sinks. Definition of terms such as DCE, DTE, Common Carrier EIA, ISO,CCITT data set etc.

REFERENCE

SINNEMA - Chapter 1

4.2 DATA COMMUNICATION

Learning Unit 2
Time: 12 Hrs

OBJECTIVE

UNDERSTAND THE FUNCTION AND CHARACTERISTICS OF SWITCHED TELEPHONE NETWORK AND TELEPHONE LINES

SUB OBJECTIVES

1 Define the terms characteristic impedence, attenuation, phase velocity, signal to noise ratio, decibel equalisation as applied to transmission lines

2 Determine the transmission losses in resistive H, T, O and PI pads

3 Sketch and explain the typical response of a transmission line with respect to charactersitic impedence, attenuation and phase velocity

4 Comment on the suitablility of a given transmission and the effect of loading

5 Describe the operation of different types of telephones

6 Define the term "Subscriber loop" and compare the operation of the step by step cross bar and electronic switching

ASSESSMENT CRITERIA

The student must be able to carry out suitable tests of telephone lines and cables.

TOPICS

Transmission Channel Measurements

Calculation and measurement of loss through resistive pads for H,T,O and PI pads, decibel units for power voltage and current and their typical application in communication, signal to noise ratio, additive noise voltage in transmission lines.

Transmission Line Fundamentals

Characteristic impedence, attenuation and phase velocity of a transmission line and its typical response to signals, for open air, twisted pair and co-axial cables, equalisation as applied to communication.

Characteristics of Telephone lines &
Telephone Instruments

Power and intellegence distribution of human speech with respect to frequency, lower and upper frequencies of a voice channel as per CCITT, loading of telephone lines and its effect on the performance of the line, operational features of mechanical and touch tone telephones, signal transmission path in a telephone circuit which includes a balancing network, need for side tone.

Switched telephone network

Operating principles of step by step, Cross bar and electronic switching, merits and demerits of each system of switching, subscriber loop interface.

PRACTICAL ACTIVITY

1 Measurement of the transmission loss through the pads

2 Measurement of characteristic impedence, attentuation and phase velocity of a transmission line using different types of cables.

REFERENCE

SINNEMA Chapters 1 & 2

4.4 DATA COMMUNICATION

Learning Unit 3
Time: 15 Hrs

OBJECTIVE

CONNECT COMMUNICATION LINES TO DATA TERMINAL AND DATA COMMUNICATION EQUIPMENT

SUB OBJECTIVES

1 List the relative merits of parallel and serial data transfer and their application

2 Define the difference between synchronous and asynchronous serial data transfer and show how the character framing is achieved in both the cases

3 Set up any switch selectable options for a given serial communication link

4 Connect properly DTE's and DCE's using different interfaces and test the link

5 Comprehend the limitations of sending base band data over a telephone voice channel

6 List the facilities of the break box and use it effectively.

ASSESSMENT CRITERIA

The student must be able to connect DTE's and DCE's through suitable interfaces and commission the system.

TOPICS

Basic Transmission Methods

Parallel and serial data transfer, their merits and demerits and application, definition of a parallel data transfer, protocol using strobe and busy hand shake and its limitation, synchronous and asynchronous serial data transfer, character framing; idle sync, operating principles of UARTS and USARTS, parity, framing errors, operation of active and passive current loop interface, RS 232-C interface and its operation, related connectors and pin number assignments balanced and unbalanced transmission and interfaces, RS 449 interface and its opertion and major differences with ES 232-C, base band signalling and its limitation, break out box and its application, use of break out box as a null modem.

PRACTICAL ACTIVITIES

1 With a 8-bit micro processor trainer provided with a programmable serial communication interface and its related software, set up the system for serial data transfer and test the serial data link

2 Given two DTEs or one DTE and DCE, physically connect the two devices together and test the serial link using the following interfaces:

i RS 232-C
ii RS 449

REFERENCE

Specification sheets and manuals relating to data terminal and data communication equipment.

4.4 DATA COMMUNICATION

Learning Unit 4
Time: 12 Hrs

OBJECTIVES

COMPREHEND VARIOUS METHODS OF MODULATION ADOPTED IN DATA COMMUNICATION

SUB OBJECTIVES

1 List the reasons for modulating digital base band signals

2 Define the difference between baud and bits per second

3 Define, sketch and list typical applications of various modulation methods adopted in data communication and describe how they are achieved.

ASSESSMENT CRITERIA

Define and explain various methods of modulation and their applicaion

TOPICS

Modulation

Analog modulation, amplitude, frequency and phase modulation, reason for modulating digital base band signals, definition of modulation index and also transmission speed, data rate and their differnences, shift key modulation bandwidth requirements application and implementation, multilevel modulation techniques, definition of dibit and tribit, encoding methods; QAM transmission scheme, delta modulator and demodulator, simple and compounded delta modulation – block diagram, operating principles and applications. Pulse code modulation, encoding and its application.

REFERENCE

SINNEMA Chapters 4 & 6

4.4 DATA COMMUNICATION

Learning Unit 5
Time: 8 Hrs

OBJECTIVE

CONNECT THE COMPUTER TERMINAL TO A HOST COMPUTER USING THE MODEM AND TEST IT FOR PROPER FUNCTION

SUB OBJECTIVES

1 Define simplex, half duplex and full duplex transmission modes

2 Assess the operation of sychronous and asynchronous modems with new applications

3 Define and list area of applications of TDM and FDM

4 Connect properly the computer terminal to the host computer

ASSESSMENT CRITERIA

Be able to connect a computer terminal to a host computer using a modem in accordance with the national regulations.

TOPICS

Modems

Low speed asynchronous and synchronous modems, their application and operation and method of connection, simplex, half duplex, full duplex transmission modes, use of originate and answer modems on a switched line. Multiplexing, time division and frequency division multiplexing and different methods of TDM and their application.

PRACTICAL ACTIVITIES

1 Study of modems
2 Testing and fault elimination and installing a modem.

REFERENCE

SINNEMA Chapter 6
Hardware Mnauals of Terminal & Host Computer.

4.4 DATA COMMUNICATIONS

Learnin Unit 6
Time: 8 Hrs

ONBJECTIVE

COMPREHEND THE COMMON SOURCES OF NOISE AND TRANSMISSION IMPAIRMENT AND METHODS OF OVERCOMING THEM

SUB OBJECTIVES

1 List the causes of different types of noise and transmission impairment and methods of reducing their effects

2 Define the various methods of error detection and list their applications

3 Define the principles of error connection.

ASSESSMENT CRITERIA

Explain error correction techniques and their applications.

TOPICS

Noise and Distortion, common sources of noise, transmission impairment and distortion, methods to reduce them.

Error detection and correction

Need for error detection, definition of parity, LRCC, VRCC, CRC, for error detection, their application, their differences and related error detection schemes, circuit diagram of a CRC generator when given the generator polynominal.

Error correction, define Hamming distance, position of check bits and determination of single bit errors, definition of the overhead and its relationship to the length of the transmitted word.

REFERENCE

SINNEMA Chapters 3, 7, & 9.

STAFF REQUIREMENTS

Grouping of Students

For instruction to be effective, the class size is recommended to be limited to 20 students. To give more personal attention to the the students in Laboratory work, workshop practices, drawing classess and tutorials, two staff members for 20 students will be needed. It is assumed that there will be two cohorts of students at any time in the institute (First year and second year). This is a recommendation, organisation may wish to organise this course to fit in with other courses already in operation.

Staff Structure

The faculty may consist of the following:

- 4 Instructors (one of them as the overall leader of the course)
- 2 Lab Assistants
- 1 Workshop Assistant
- Secretarial Assistance.

THE COURSE LEADER

Job Functions:

* Analysing the curricula prescribed for the course
* Assessing and arranging the material & resources required for the conduct of the course
* Advising/arranging the instructional resources required for the implementation of this course
* Planning, organising and supervising examinations/ tests and assessing students' performance and maintaining students' records and other admininstrative tasks
* Developing close liaison with industry and institution
* Planning and delivering theoretical & practical instructions
* Carrying out administrative functions.

Background:

- Experience in conducting technician courses in servicing and maintenance of electronic equipment particulary micro computers
- Work experience as a computer maintenance technician
- Familiarity with pedagogical methods
- Experience in the administration of technican courses related to electronic trade
- Ability to liaise with neighbouring computer industries.

INSTRUCTORS

Job Functions:

* Analysing the curricula in respect of subjects he/she has to teach
* Planning delivering and evaluating theoretical and practical instructions in subjects allocated
* Selecting and designing suitable sequence of activities for all practical exercises
* Conducting, supervising examinations/tests and assessing students' performance.

Background:

Same as for the Course Leader.

LAB ASSISTANTS

Job Functions:

* Arrange materials, instruments, tools and equipment required for laboratory work
* Prepare circuits for testing
* Maintain the instruments tools and equipment in working condition
* Check equipment, connection etc. before students operate them
* Assist students in their practicals and project works
* Receive, store and issue materials, instruments, tools and equipments required for laboratory work.

Background:

- Experience in conducting practical classes for Basic Electrical engineering, Electronics including Micro processors and micro computers
- Extensive experience in micro computer servicing and maintenance and also handling various electrical instruments and electronic test equipment.

WORKSHOP ASSISTANT

Job Functions:

* Procurement/storage/accounting of raw materials, tools and instruments
* Issue of materials/tools/equipment for workshop exercises
* Guide the students in the workshop exercises
* Maintain equipments and machines including preventive and breakdown maintenance
* Assist students in the fabrication of their projects.

Background:

- Experience in conducting practical classes with safety practices in sheet metal work and fabrication
- Experience in maintaining tools, equipment and machinery used in a sheet metal shop.

RECOMMENDED LIST OF EQUIPMENT AND MACHINERY
(To cater to 20 students)

I ELECTRONICS LABORATORY

Sl.No.	Name of Equipment	Nos Reqd	Approx Cost in US $
1	0-30V DC, 1A variable power supply	10	1000
2	±15V, 1A power supply	5	300
3	+5V, 3A power supply	10	750
4	IC training system	10	2000
5	Microprocessor training kit	10	3500
6	Analog standard multimeters	5	1000
7	Digital multimeters	10	1000
8	Dual trace oscilloscope (20 MHz)	5	5000
9	Logic probe	10	1000
10	Pulse generator	5	5000
11	Function Generator	2	550
12	Frequency counter	2	500
13	Audio oscillator	3	450
14	Cassette recorder	2	200
15	Dumb terminal	1	1000
16	EPROM programmer as plug-in card in IMB/PC	1	400
17	EPROM Eraser	1	200
18	Stepper motor	2	100
19	Servo motor	2	100
20	Universal FHP motor	2	100
21	DC shunt motor (small size)	1	50
22	DC series motor (small size)	1	50
23	Single phase induction motor	1	50
24	3 phase induction motor (small size)	1	100

25	Servo stabilizer	2	600
26	Single phase auto transformer	1	100
27	3 phase transformer	1	1000
28	Voltmeter, Ameter		300
29	Wattmeter, Energy meter, Meggar		800
30	Rheostats		400
31	DC Batteries with hydrometers and capacity testers		300
32	A.C. millivoltmeter		100
		Total	24000

LIST OF EQUIPMENT AND MACHINERY
(To cater to 20 students)

II MICRO COMPUTER LABORATORY

Sl.No.		Nos Reqd	Total Cost US $
1	Digital multimeter	10	1000
2	Single Beam CRO with good trigger sweep facility 100 MHz	5	20000
3	Dual Trace CRO 100 MHz Verical & Horizontal sensitivity ± 3%	5	25000
4	Data analyser boards for PCs to be used as adapter card	1	250
5	Break out boxes	3	600
6	Logic Pulsers	10	1500
7	Low cost logic analyser	2	2000
8	Synchronous modems	2	1200
9	Asynchronous modems Hardware	2	1200
10	IBM PC 386 based compatible with colour Monitor additional fixed disk 20 MB drive, light pen, mouse, joystick and digitiser	10	40000
11	Alignment disks and head alignment tools	2	250
12	Personal computer cluster adapter	2	250
13	Personal computer cluster cable kit	2	250
14	Suitable Network facilities		5000

SOFTWARE

Operating system (MS-DOS)

Assembler, Linkage editor

High level languages: BASIC.,

PASCAL, C, FORTRAN, COBOL

Autocad, Orcad

Editor

Wordprocessor

Diagnostics Program

System Utilites dBASE III,
LOTUS 1-2-3

Networking Software

Personal Computer Cluster
Programs

Video cassette on trouble-shooting

It is expected that the cost of the software and licenses will not be less than £20,000.

The total cost for the equipment and software is estimated at 142,500. Prices are for equipment surveyed during 1989. It is appreciated that wide variations exist in many countries.

LIST OF EQUIPMENT AND MACHINERY
(To cater to 20 students)

III WORKSHOP

Sl.No.	Name of Equipment	Nos Reqd	Total Cost in US $
1	Work benches fitted with vices	10	1000
2	Solder stations	10	1000
3	Crimp tools	10	1000
4	Wire wrap tools	10	2000
5	Circuit Board Holders	10	500
6	Power hacksaw	1	500
7	Bench grinders	2	400
8	Portable grinder	1	200
9	Tool kits (chissels, hammers, files, hacksaw etc)	10 sets	1000
10	Tap and dies	2 sets	100
11	Calipers, V-bloacks, steel rulers scribers	10 sets	500
12	Bench drills	4	1200
13	Hand drills	2	250
14	Metal shear (lever & guillotine types)	1each	500
15	Metal binding machine	1	500
16	Welding generator set & kits	1	1000
17	Spot welder	2	450
18	Metal Spray gun	1	400
19	Electric blower and vacuum cleaner	1each	300
20	PCB making facility with darkroom cameral, enlarger and etching equip		4000
		Total	16800

Total capital equipment cost - 169,300

B. CONSUMABLE ITEMS - 7,500 US $ pa

GENERAL NOTE ON EQUIPMENT & PHYSCIAL FACILITIES

1 The total cost for equipment will be 170,000 US $ which does not include the import and customs duty, transport, local taxes etc. The countries importing these equipments must consider these expenditures as additional costs in their estimates.

2 The total cost of equipment per student comes to 4250 US $ considering 2 cohorts of students at any time in the training institution.

3 Since students will be practising disassembly and reassembly of various peripherals it may be necessary to keep in mind the life expectancy and obsolescence of equipments since they may have to be written off in over 5 years. Hence the budget must be planned accordingly.

4 In addition to the capital equipment, expenditure to an extent of 5% of the capital cost is to be budgetted for consumables per annum.

5 Since equipments available in various labs and workshops connected with other electronic courses can be utilised for this program, the cost of equipment for this program will be less than the above estimate if common lab facilities are already available.

6 The Norms recommended for classroom & laboratory spaces are

i 2 sq.m. per student with a minimum space for 55 sq.m. for a classroom;

ii 5 sq.m. per student for lab and workshop with suitable furniture.

7 Classrooms, labs and workshop to be provided with suitable electrical installation and the Computer Lab to be air conditioned.

8 Overhead projectors (OHP), slide projectors, TV receivers with VCR are to be provided in the classroom.

ACRONYMS USED IN THE DOCUMENT

A.C.- AC - a.c.- ac -	Alternating current
ACK 0	Acknowledge "O"
ACK 1	Acknowledge "1"
A/D	Analog to Digital
ALU	Arithmetic Logic Unit
BASIC	High Level Language
BC	Silicon Low-Frequency Transistor
B-H	Hysterisis Loop
BY	Silicon Power Diode
CMOS	Complementary Metal Oxide Semiconductor
CODEC	Coder-Decoder
CP/M	Control Program for Micros
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
D.C.- DC - d.c.- dc -	Direct Current
D/A	Digital to Analog
DCE	Data Communication Equipment
DLE	Data Level Escape
DMM	Digital Multi-meter
DSDD	Double sided Double density
DTE	Data Terminal Equipment
E.H.T- EHT -	Extra High Tension
EIA	Electrical Industries Association
ENQ	Enquiry

EOT	End of Transmission
ESD	Electro Static Discharge
ETX	End of Text
FET	Field Effect Transistor
HDLC	High Level Data Link Control
IC	Integrated Circuit
IEEE	Institute for Electrical and Electronics Engineers
I/O- I-O-	Input Output
ISO	International Standards Organisation
K - KB-	Kilo-Bytes
LED	Light Emitting Diode
LRCC	Longitudinal Redundancy Character Check
LSI	Large Scale Integration
mA	milli-Amperes
MS DOS	Disc Operating System by Micro-soft
mt	Minute
NAK	Negative Acknowledge
OHP	Overhead Project
OP-AMP	Operational Amplifier
QAM	Quadratine amplitude Modulation
PC	Personal Computer
PCB	Printed Circuit Board
PCU	Peripheral Control Unit
RAM	Random Access Memory
ROM	Read only Memory
R/W	Read and Write
RLC/-	

R-L-C-	Resistance-Inductance-Capacitance
RX	Receiving
SCR	Silicon Controlled Rectifier
SDLC	IBM's Link Control
SOH	Start of Header
SSSD	Single Sided Single Density
STX	Start of Text
SYN	Synchronisation Characters
TOBIT	Two Bits
TRIBIT	Three Bits
TTI	Transistor Transistor Logic
TX	Transmission
UART	Universal Asynchronous Receiver and Transmiter
UG	Underground
UJT	Uni-Junction Transistor
UPS	Uniterruptible Power Supply
USART	Universal Synchronous and Asynchronous Receive and Transmitter
V	Volts
VCO	Voltage Controlled Oscillator
VCR	Video Cassette Recorder
V-I	Volt-amperes
VLSI	Very Large Scale Integration
VRCC	Vertical Redundancy Character Check
XENIX	Unix Version for Micros.